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A Public Transportation Plan for Colorado's Regional Transportation District

Regional Transportation District

March 1973

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A Public Transportation Plan

for Colorado's Regional Transportation District

Summary Report

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March 1973

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The report describes a recommended public transportation plan for the seven-county regional transportation district. It is a report of three years of activity which led to the recommendation of the public transportation system RTD believes will best meet the needs of the District. Within this time period studies were conducted on the region's specific transportation needs. RTD identified the transportation services which would satisfy those needs most efficiently. The proposed transit system was further tailored to the region as services were applied. Next, RTD examined what would be involved in implementing the system. Finally, RTD studied methods of financing a transportation system for the District.

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A Public Transportation Plan

for Colorado's Regional Transportation District

Regional Bus
Express Bus
Local Bus
Bus Shelter
PRT
PRT Station
Park and Ride

Summary Report

March 1973

**COLOR ILLUSTRATIONS REPRODUCED
IN BLACK AND WHITE**

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This report is a summary of technical information to be published that will discuss in detail a preliminary system design, benefit/cost analysis, and an implementation plan. The technical information will be available for study at the offices of the Regional Transportation District, 56 Steele Street, Denver, Colorado. Earlier interim reports on specific subjects published by the Regional Transportation District include:

Socio-Economic Projections
Regional Goals and Transportation Objectives
Financial Resources
Transportation Systems and Technology - Issues and Trends
Regional Growth, 1971-2000
Ecology: Natural Suitabilities for Regional Growth
Phase I - A Concept

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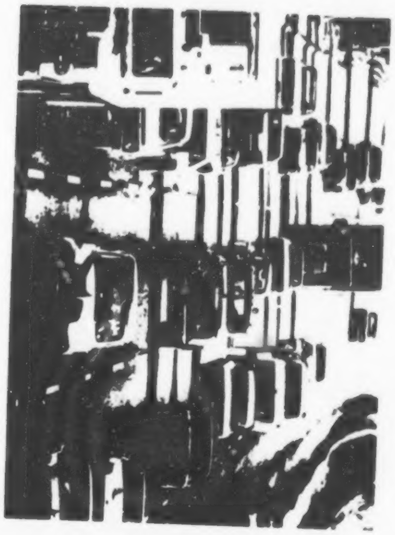
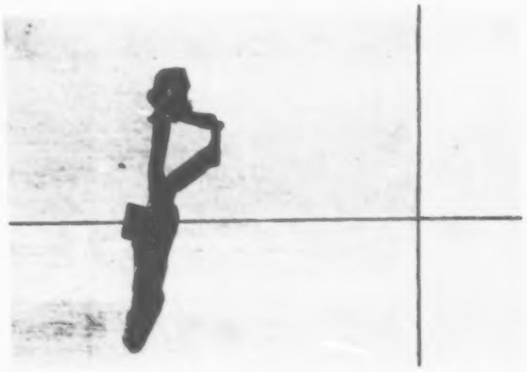


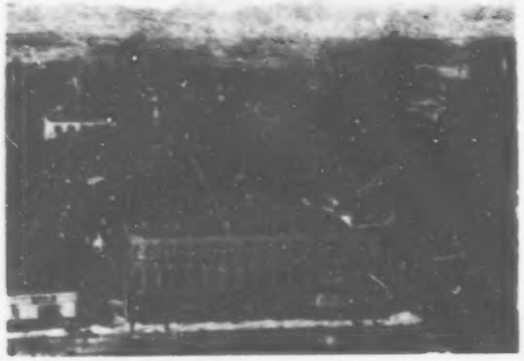
Preface

Described on the following pages is the recommended public transportation plan for the seven-county Regional Transportation District (RTD) tentatively adopted by its board of directors at a February 15, 1973 meeting.

This is a report of three years of activity which led to the recommendation of the public transportation system RTD believes will best meet the needs of the District. Within this time period vast studies were conducted on the region's specific transportation needs and their related impact on life style. RTD identified the transportation services which would satisfy those needs most efficiently. The proposed transit system was further tailored to the region as services were applied to routes. Next, RTD examined what would be involved in implementing the system. Finally, RTD studied methods of financing a transportation system for the District.

The transit plan will be presented to residents of the District at public hearings before a final plan is determined. The final step will be the submittal of a program for financing the implementation of the plan to the voters of the District for their approval.





View of Denver
from State Capitol, circa 1900.

View of Denver from State Capitol, 1973.

1

Why Transit for This Region

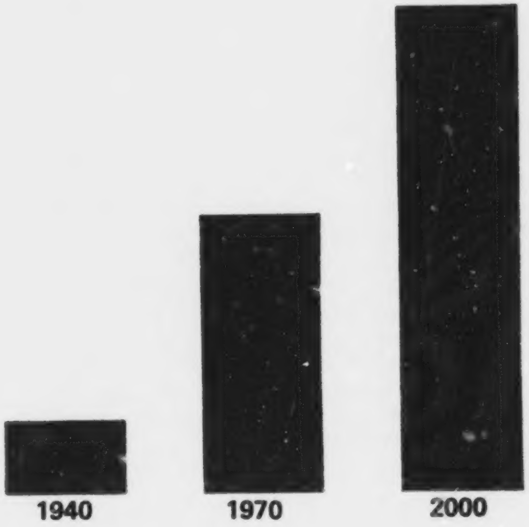
Colorado's Front Range region, once the gateway to the Rockies for the pioneers of a century ago, has become today, the center of financial, business and cultural activity of the entire Rocky Mountain West. The principal city of the region, Denver, has become one of the nation's major metropolitan areas. The change has brought both problems and opportunities—problems that are not so serious that the opportunity doesn't still exist to solve them, if the citizens of this region act soon.

Many Americans who haven't visited this area in recent years still view it as it was 20 years ago. Many Coloradans reluctantly admit that things aren't the same as they were. Smog now frequently obscures the mountains, especially during the winter months; the rolling countryside is dotted with houses; and traffic jams are a part of daily life. Towns, such as Broomfield and Northglenn, have developed on former pasture and farmland. Throughout the region, the problems which once were Denver's alone, now belong to everyone.

Not long ago growth was encouraged. Today even the most enthusiastic community booster stops short of backing uncontrolled growth. *Land use controls* and *planned development*, preservation of the *ecology* and the *environment* are new terms in the everyday vocabulary. While Denver's population has remained relatively static, in only 10 years, between 1960 and 1970, Longmont has grown from 11,000 to more than 23,000; Boulder, from 37,000 to 67,000; Aurora, from 48,000 to 75,000; Littleton, from 13,000 to 26,000; and Arvada, from 19,000 to 47,000. Two counties in the region—Jefferson and Boulder—rank among the top 25 fastest growing counties in the nation.

The pressures this growth has placed on the communities and residents of this region for new schools, sewers, roads and other services have been great. While some would hope to halt growth completely, many recognize that growth will happen—the pressure is too great—and have turned their energies toward making use of the planning tools which can control and direct growth. Estimates are that the region's population will almost double in the next 30 years. Mistakes can be avoided only if the region both plans and takes necessary action *now* to prepare for the future.

A region is able to check its growth to some extent, to control how and where it takes place, and to govern its effects on the environment. This region must do so if it is to avoid growing up from a young Los Angeles—with which it is frequently compared—to a present-day Los Angeles, a city struggling with problems its residents waited too long to face. Colorado's Front Range faces these problems today, but still has time to employ tools of



Population of Seven County Region

urban planning which can have substantial impact on the character of a community. Transportation is one of the most important of these tools.

The quality of transportation services often sets the stage for the impression a community leaves on its inhabitants and visitors. New York is remembered for its subways and once for its double-decker buses, Chicago for "the Loop," San Francisco for its cable cars and for the new BART rapid transit train, and Los Angeles for its acres of freeways and complex interchanges. Colorado's Front Range region could follow the lead of Los Angeles, building more and more highways.

Why not continue only to improve facilities for the automobile? The answer is not simply that the auto today contributes 90 percent of the region's air pollution—tomorrow science may find a clean auto.

Dependence on the auto is an expensive solution to transportation needs, and the cost comes not only in the construction of highways. Acres of land must be devoted to freeways and parking lots, accidents take a toll of life and property, and inevitable traffic congestion steals time. Yet 25 percent of the population remains isolated without a means of travel. They are the young, aged, poor and handicapped who either cannot drive or cannot afford a car.

Transportation can form urban patterns, and the form characterized by over reliance on the automobile is known as urban sprawl. The auto requires land for parking, streets and highways that force new development to spread on the fringes of existing residential areas. Land is swallowed up in ever-widening circles of low density, single home development. Utilities must spread out in a complex, costly network. Grain fields and pastures give way to housing projects. Transit encourages organization of housing, shopping, medical facilities and other community services into less space, leaving more open space for parks, green belts, and agriculture.

Land, an increasingly valuable asset, is used to its best advantage by public transit. Thousands can travel over a narrow belt of acreage devoted to rapid transit; that same land would accommodate only hundreds if it were converted to a highway.

But if public transit is such a panacea, why has ridership declined in many metropolitan areas as ex-passengers return to the auto as a primary means of transportation in spite of its disadvantages? The majority of the American public is capable of owning an automobile. Many of the remainder will sacrifice other conveniences just to own a car.

The auto is convenient, comfortable and private. To lure people from their autos, public transit must be just as convenient and comfortable, if not more so. Most public transit systems in this nation pre-date the invention of the auto. The newer systems, such as the Lindenwold Line in Philadelphia, the Montreal subway or BART in San Francisco, have successfully challenged the auto in speed, convenience, cost, safety and attractiveness. New systems with features such as these and more will be necessary in the future to compete with the automobile.

Balanced transportation, which must include good public transit, takes best advantage of *all* modes of travel. The automobile will continue to be a vital part of the transportation scene. For many of the short trips to neighbors' homes or to shopping, the auto plays an important part in a balanced transportation system. For the long distance family trips, nothing quite compares with the intimacy and privacy of the auto.

But the auto should not be the sole means of transportation in any developed area. It must be part of a balanced transportation system in which public transit serves those needs that best suit its capabilities. The alternative is continuing air pollution, increased congestion, haphazard development, wasteful expenditures of land, and lack of transportation of any kind for many residents of the area.

Recognition that an alternative to the automobile must be found, if many urban problems of Colorado's Front Range are to be held in check, encouraged the residents of the region and eventually the Colorado General Assembly to act. In 1969, an authority was created to study the transportation requirements of the Front Range and present its findings to the people of a contiguous seven-county area. That authority is the Regional Transportation District. The story of RTD and the transportation plan it recommends to the citizens of the District are outlined on the following pages.

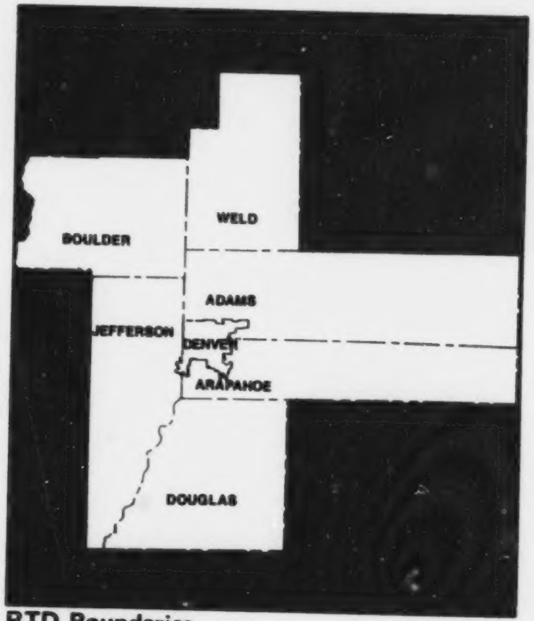
2

Action to Meet a Need

Foresighted legislators, encouraged by support from citizens and organizations in the state, recognized that creative action would be necessary if the growing problems of the rapidly expanding Front Range of Colorado were to be met head on. The problems such as air pollution and traffic congestion, extend across county lines and are too large to be tackled effectively by a local government agency.

RTD Is Organized

The 1969 Colorado General Assembly passed the Regional Transportation District Act with the very specific assignment of planning, developing, operating and maintaining a public transportation system in the seven counties of Adams, Arapahoe, Boulder, Denver, Douglas, Jefferson and Weld. An amendment to the RTD Act later limited Weld County's inclusion to only the southwest corner.



RTD Boundaries

The RTD Act provides for responsibility to local governmental authorities—20 of the RTD directors are appointed by county commissioners with approval from municipalities and a 21st is elected at large. In Denver County, directors are appointed by the mayor with the concurrence of the city council. The RTD can levy up to .50 mill for planning purposes—but so far the maximum levied by RTD has been .42 mill and the current levy is .35 mill. The act ensured prompt action by RTD—a plan for a system and its financing must be submitted to the voters of the District, and approved, before July 1, 1974, or the RTD must dissolve.

Getting Started

The RTD Act became effective July 1, 1969. Organizational planning and local governmental appointments and confirmations of the 21-member board of directors were the first necessary steps. The initial meeting of the board was held that fall and officers were elected in November.

With the board completed by February of 1970, RTD began hiring staff and opened its offices. Board members visited other transportation authorities in the country to better understand the task before them. Broad objectives were established to outline both a course of action and the eventual goals RTD planned to accomplish in the development of a public transportation system as follows:

1. To provide maximum feasible integration of public transportation planning and implementation with comprehensive land use planning. This identifies and helps create the best urban form as defined by the Front Range land use plan.

2. To maintain a regional rather than a parochial vision of responsibility in evaluating, developing and/or operating intra- and interurban transportation systems.

3. To strive for a balanced ground and air transportation system which protects, enhances and accomplishes the highest level social, economic and environmental objectives.

4. To involve citizens of the District whereby they can:
   a. assist in identifying their transportation needs and problems,
   b. weigh possible alternative solutions,
   c. understand, approve and assist in implementation of the solutions.

5. To help preserve inter- and intra-urban transportation systems, while continuing sequential development of the overall District transportation plan, which would make maximum utility of these systems.

6. To provide a unification of all transportation planning in the District through close liaison with those agencies and organizations with related responsibilities and concerns.

7. To inform the general public and governmental agencies of the District's goals, objectives and progress of implementation.

Selecting a Consultant

The next step was to employ the professional talent necessary to accomplish the objectives. The District decided to seek a consultant that could carry out the planning under the direction of a small, experienced RTD staff.

RTD reviewed proposals from 13 potential consultants and in February, 1971, selected the Joint Venture team of Development Research Associates (DRA) of Los Angeles, and Wallace, McHarg, Roberts and Todd (WMRT) of Philadelphia.

The Joint Venture recommended a different approach to transportation planning that promised an innovative transportation system. That system, if implemented, would be a positive influence on the region and still meet the mobility requirements of its residents. Each member of the team brought special talents to the task. DRA is noted for urban and transportation planning related to socio-economic assessments. WMRT is a leading firm in ecological and environmental analysis, urban planning and design. Other special talents have been added to the team by Joint Venture as necessary, such as Kaiser Engineers of Oakland, California, for engineering analysis.

Regional Planning

Transportation is an important planning tool, yet it can only be effective when all parties which control its application to the community can participate in its development. The RTD Act specifies that "the plan shall be prepared in such a manner as to coordinate the proposed mass transportation system with other aspects of transportation in the District, including state and county highways and arterial streets."

To fulfill this challenge, RTD entered into agreements with the Denver Regional Council of Governments (DRCOG), and the Colorado Division of Highways (CDH) to establish the Joint Regional Planning Program. RTD worked directly on a similar program with Weld and Douglas Counties, which are not part of DRCOG.

This cooperative program was developed early in the planning stages and the work of the RTD consultant team has been both coordinated with and incorporated into the Joint Regional Planning Program. All agencies participated in an extensive survey of the travel patterns of District residents, conducted in the summer of 1971. Each agency had a definable major responsibility—DRCOG for the land use plans of the region, CDH for analysis of highway requirements, and RTD for development of public transportation plans. However, the three major areas of consideration were developed jointly.

While this RTD report discusses in detail only the public transportation plan, it is an element of the broader Joint Regional Planning Program. Final responsibility for explanation to the public and implementation of each element of the program rests with the respective individual agencies. This report deals with the responsibilities of RTD related to public transportation.

Planning in the First Year

The first step undertaken during 1971 by RTD and its consultants set the stage for development of the transportation plan the following year. Since RTD had decided to offer a transportation system that would support and encourage a desired pattern of land use, the District had to inventory the region before it could begin to assess its requirements for public transportation.

One of the first steps was to define and map the major ecological characteristics of the region, including climate, geology, soils, vegetation, hydrology and wildlife. A team of local experts, drawn primarily from the Colorado State University staff familiar with the region, collected data under the supervision of the RTD consultants. The end result was a synthesis of all elements of the natural setting into a pattern that defined those areas of the District most suitable for future development and also those areas that should be protected from development for proper conservation of natural systems. The analysis was the first ever undertaken as part of a transportation study.

A similar inventory of the social and cultural or man-created factors that are interpreted as community values was the second step. Transportation should serve existing needs *and* prepare for future growth patterns and transportation requirements. A part of this analysis was the prediction of future trends for the region. This included an analysis of the area's population which nearly tripled in the three decades leading up to 1970 and is expected to increase from 1,408,000 to 2,560,000 by the year 2000. RTD consultants also mapped the location of vacant land, community facilities, employment, recreation, commercial and industrial land use, and other cultural factors of the region.

The ecological and cultural analyses were coordinated into a single matrix that showed those areas that were more undesirable for future urban development because of hazards to the environment and a dearth of cultural opportunities, those areas that are desirable for converse reasons, and those that are neutral.

A Concept

At the close of Phase I in January, 1972, a report was issued by RTD that summarized the findings of the previous year, and concluded with a regional transportation concept designed to reinforce a regional land use concept. The transportation concept was formulated on the following guidelines:

1. The transportation system must be designed to serve present needs and meet current transportation problems.

2. Development should be directed away from areas which the ecological inventory identified for protection.

1972 Denver Post Opera, Cheesman Park

3. Uncontrolled or minimally controlled suburban sprawl is detrimental to the region.

4. The transportation system should reflect a family of technologies, each designed to best meet specific needs.

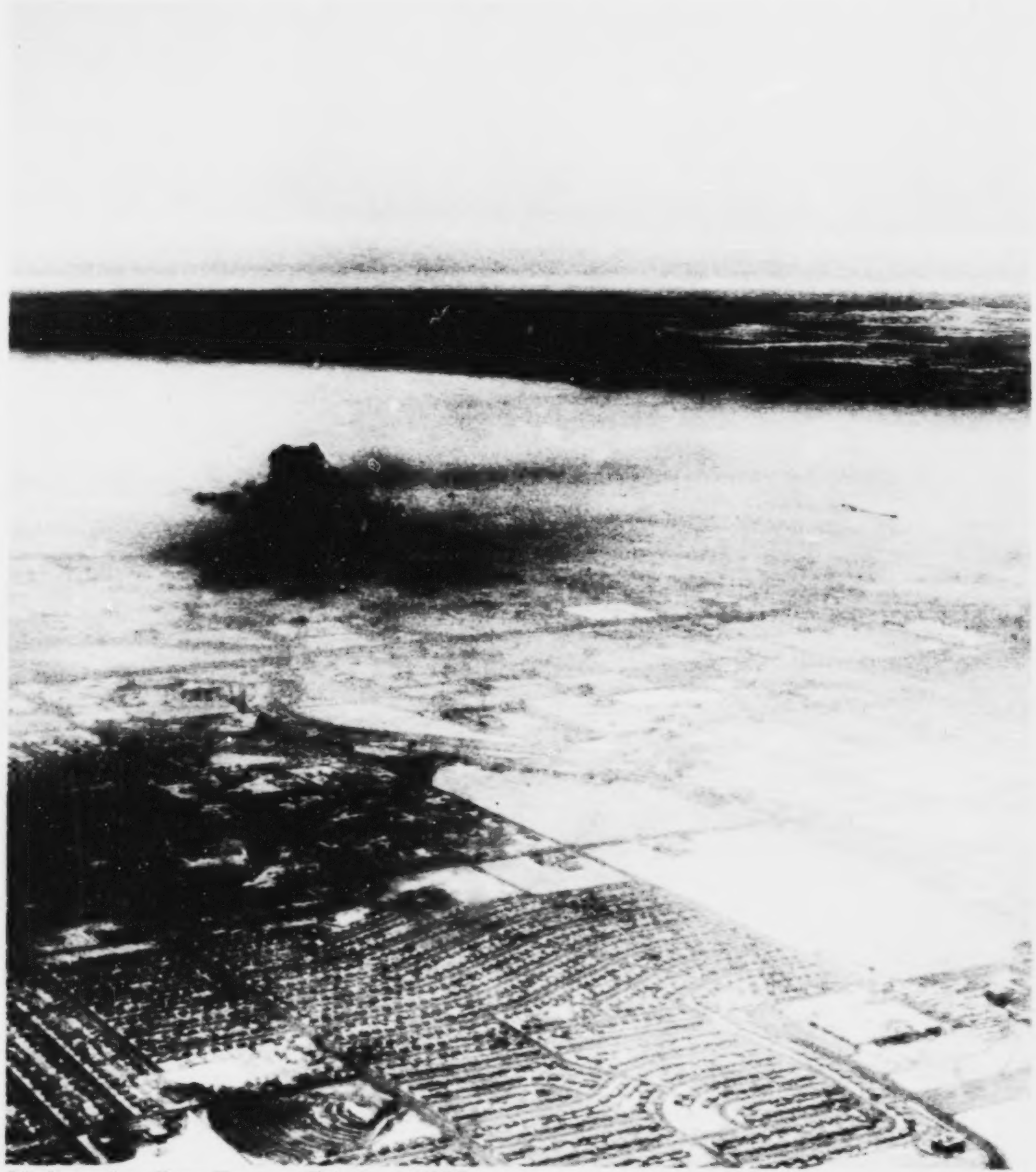
5. The transportation system should be designed to be staged over a period of time to meet changing needs of the District.

An effective urban transportation system will continue to develop facilities for the use of the automobile in those roles for which it is best suited. It will also offer other modes of transportation including pedestrian, bicycle, and higher speed, higher capacity public transportation. Transit, working in harmony with all other forms of transportation, can permit a wider range of living patterns or life styles, some of which are unattainable when the automobile is the sole means of transportation.

Involving the Community

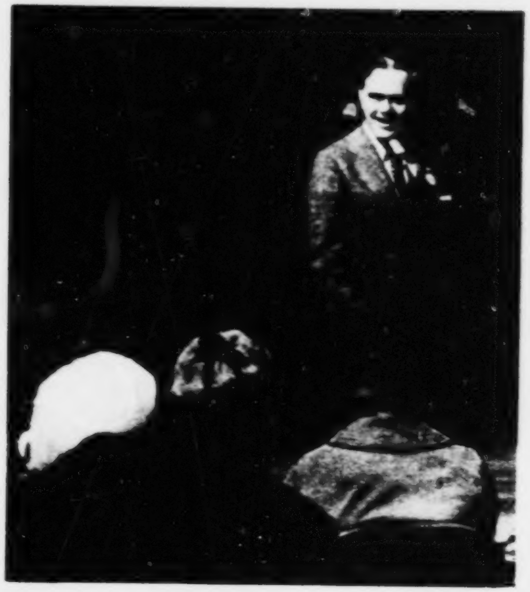
While a major contribution to the Joint Regional Planning Program is the participation in the overall planning on the part of local governments through their representation in the Denver Regional Council of Governments, further steps were taken to solicit response directly from the communities to be served by the RTD system. This effort was developed first through the elected and appointed representatives of the counties and communities in the District.

Information collected during the first year outlined the economic, social, environmental and ecological characteristics and the objectives and plans of each county and community in RTD. Teams were organized by RTD, one for each county, to explain and discuss the information with local planning departments and commissions, and with elected



Air Inversion Over Denver, February 1965 officials. The local representatives were asked to update RTD information and provide additional details on current planning, area characteristics, and the type and level of transportation each community thought it needed and would support. The transportation concept, in combination with the land use concept, provided the basis for this discussion.

Involving the community in preparation of a recommended plan went one step further when wide dissemination of information was made through newsletters, publicity and displays on RTD's preliminary transportation concept. Citizen Advisory Committees (CAC) were formed in each county of the District. The members met regularly for briefings on RTD progress, and they reviewed and commented on reports prepared by RTD. Committee chairmen attended board meetings to express the thoughts of the CAC members to RTD directors. They helped organize briefings for residents of the District, at which the concept was explained and comment was solicited on specific elements of it.



In all, during 1972, RTD representatives held 148 briefings for local officials throughout the District, held a series of 37 "public forums" on neighborhood levels, and spoke at 162 meetings of organizations. As a result an estimated 6,000 citizens have had first hand exposure to RTD's plans during the past year.

The information developed with the help of both officials and residents was summarized and distributed to all connected with RTD, from board members to staff and consultants. In the months ahead, this goal of community involvement in the plan will be carried a step further to formal public hearings, as well as a continuation of the briefing and discussion sessions that have been held.

While RTD was formulating a public transportation plan, it also was working with the Joint Regional Planning Program to arrive at both a regional highway plan and a regional development plan. The goal has been to coordinate the three plans into a total positive plan for the future of the region.

Preliminary Regional Highway Plan

The transportation concept adopted by the Joint Regional Planning Program stated that in order to achieve the desired regional objectives of:

1. accessibility,

2. socially, environmentally and economically conscious development, and

3. equitable costs and benefits,

the total transportation system must serve three functions:

1. resolve immediate transportation problems,

2. reinforce and organize the development of existing regional centers, and

3. serve and encourage development in new regional patterns, as defined by the development concept.

Beginning from its present position of dominance as the principal component of the total regional transportation system, the street and highway system must continue to perform its required functions. However, it also must recognize the necessity to allow the public transportation component to develop in conjunction, serving an increasing portion of the region's transportation requirements.

Street and highway facilities and the public transportation elements together represent a balanced transportation system, and must work in concert to achieve the desired level of mobility.

The two major elements of the transportation concept—highways and transit—can play a significant role in changing the existing pattern of urban development and in stimulating a more desirable pattern of development within the region. The transportation concept should be used to give impetus to development in those areas of higher suitability and where adverse ecological and environmental impacts are minimized. It should be recognized that full implementation of the total transportation concept can only be accomplished over a long period of time.

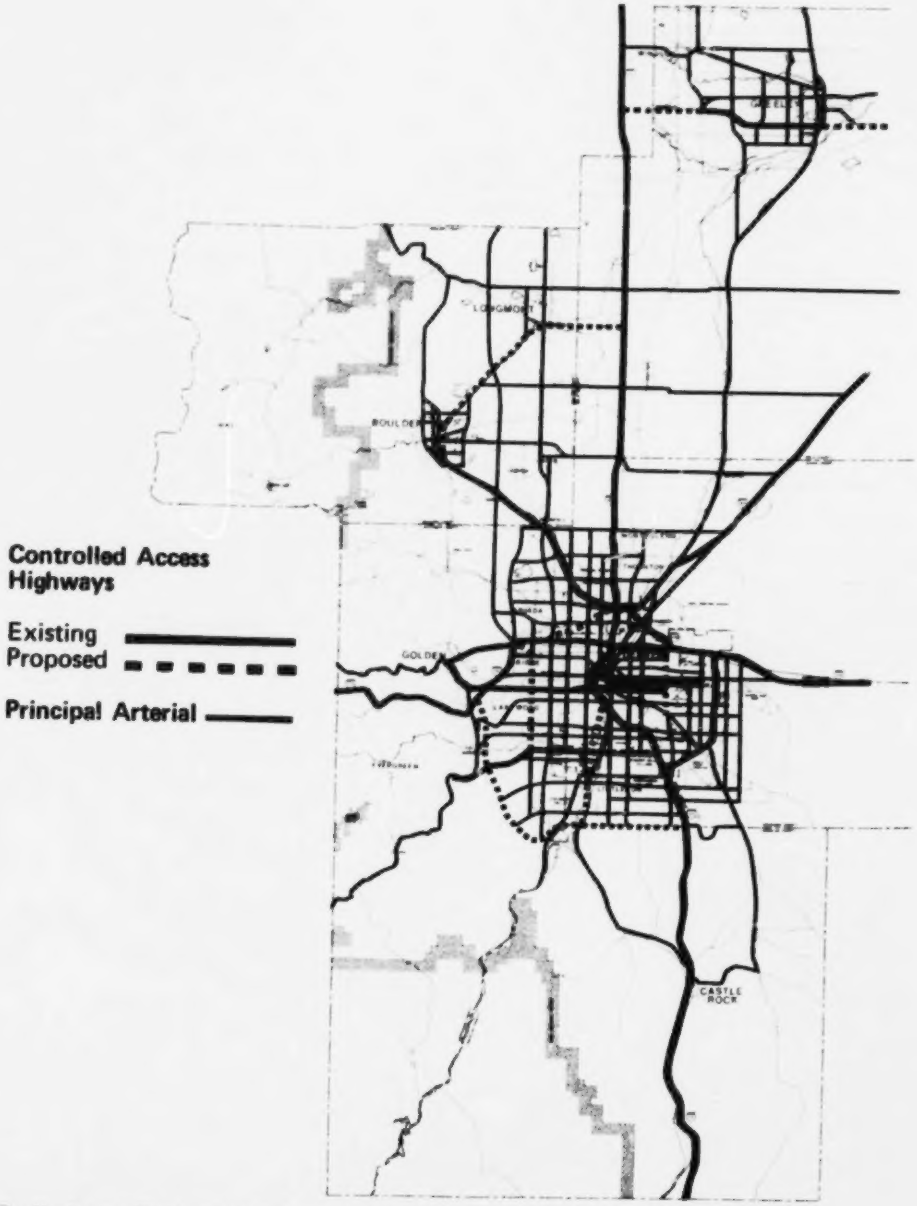
The preliminary highway plan for the year 2000 has been developed in conjunction with the public transportation system by the Joint Regional Planning Program to provide an adequate level of future highway service over the entire region. The plan represents a highway network which will permit the increased number of personal vehicles anticipated by the year 2000 to circulate efficiently throughout the region.

The identification of a particular street or highway facility as a functional element of the plan does not assure the development or construction of the facility. The plan simply indicates a desirable highway system which will provide a given level of service. Realization of the plan, in whole or in part, is still within the decision-making process of the governmental entities involved. Specific highway projects and the phasing of development of the regional highway network will be subject to design and locational detailing, will undergo social, economic, land use, political and environmental analyses, and will require community acceptance prior to implementation. It is presented here as evidence of the Regional Transportation District's compliance with its statutory requirement and as an indication of the total future transportation needs of the District.

Preliminary Regional Land Use Plan

The public transportation plan, together with the preliminary regional highway plan just discussed, has been developed in coordination with the preliminary regional land use plan. With much basic information provided by the RTD ecological and environmental analysis, the Denver Regional Council of Governments, as a participant in the Joint Regional Planning Program, is coordinating the development of this element.

The preliminary regional land use plan consists of a number of policy statements and a plan map which graphically represents those statements. The policies are designed as explicit value statements upon which future development decisions can be based. A number of concerns are addressed by the



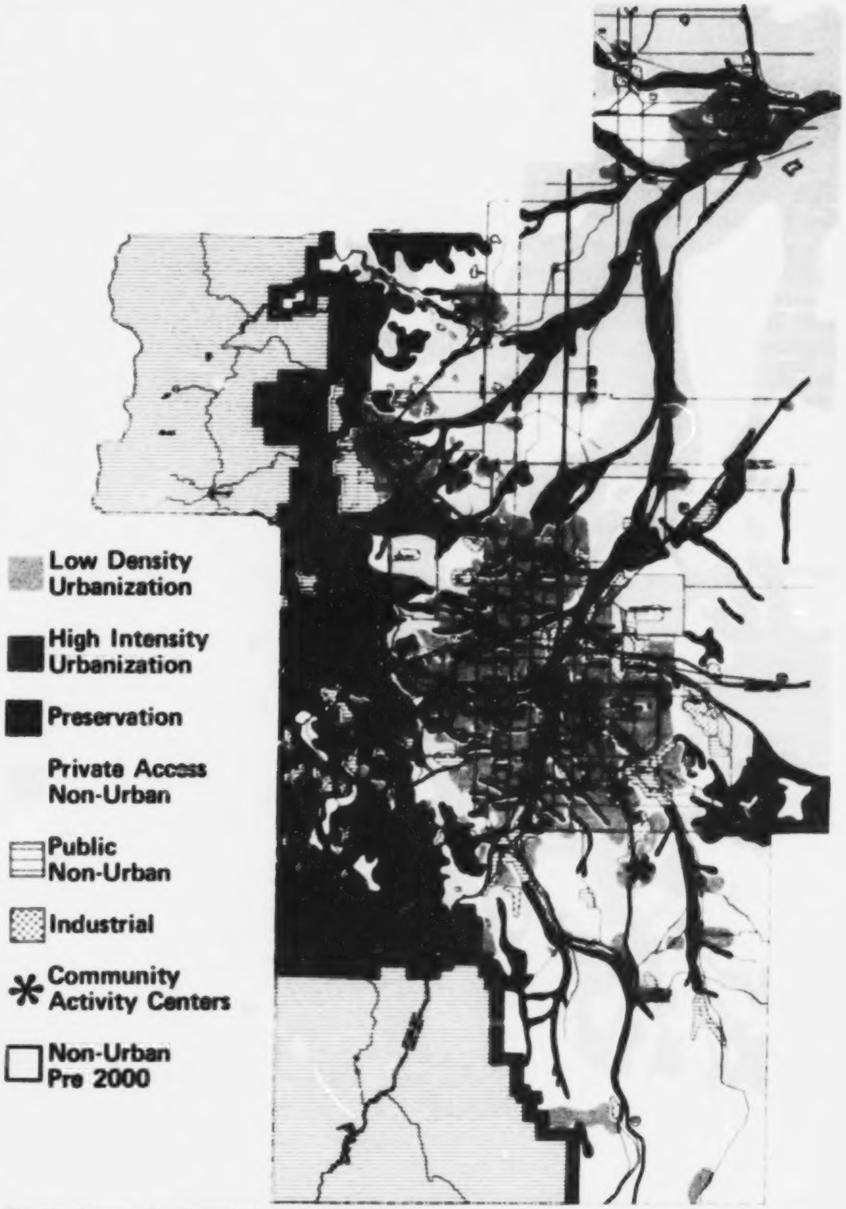
Preliminary Regional Highway Plan

plan policy statements, including:

- a regional population level, population distribution, and growth rate
- open space and conservation area protection and retention
- recognition and preservation of major areas of ecological, environmental or historical significance
- the re-orientation of the urban development pattern away from the traditional dispersed suburban development
- identification and encouragement of major higher density centers within the region
- selective encouragement of major new industrial or employment concentrations based on total regional and/or state impact
- encouragement of regional development in appropriate locations consistent with local policies and environmental considerations.

The explicit plan policies and issues they specifically address raise an additional number of implied considerations concerning various aspects of regional development. Included in these implied considerations are:

- a state-wide policy on population distribution
- local recognition of and adherence to suggested population levels
- encouragement of a pattern of regional and metropolitan development which can be effectively and efficiently served by high level public transportation systems.


Low Density Urbanization
High Intensity Urbanization
Preservation
Private Access Non-Urban
Public Non-Urban
Industrial
Community Activity Centers
Non-Urban Pre 2000

Preliminary Regional Land Use Plan

- revision in utility service extension policies

These issues are currently being addressed at the state level by the General Assembly and the Land Use Commission.

The intent of the plan is to provide guidelines for development of the region over the next 30 years that will preserve and protect existing communities and the natural resources of the region, and control the location and extent of new development. The preliminary regional land use plan recognizes major urban communities within the region which are surrounded by contiguous peripheral development but separated from each other by designated non-urban space or conservation areas.

Within the metropolitan area and to a lesser degree in other urban communities a pattern of high density corridors and community activity center locations are identified. A high level public transportation system is designed to serve these higher density areas, reinforcing their development and providing a supplementary and alternative form of transportation throughout the region.

A basic value recognized in the development plan is the concern for the ecological systems of the region and the need for development to take place in recognition of these systems rather than in spite of them. The plan indicates general areas throughout the region where new development can be suitably accommodated. The preliminary highway plan and the public transportation plan reinforce the direction of new development into these areas.

The necessary ingredient to transform the recommended regional land use plan into an effective guide for development is a rigorously enforced implementation program. Despite the lack of an overall control, the systematic use of available implementation tools, such as water and sewer service, zoning controls, and limitations on local subdivision and building approvals, can be effective in beginning to re-orient the pattern of regional development in a manner consistent with the recommendations of the preliminary regional land use plan. This depends on local understanding and consensus with the objectives and general form of the plan.

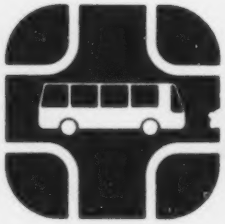
A Plan for RTD

The public transportation plan that follows in this report represents a synthesis of the information developed during the past two years—the ecological and socio-economic surveys, the regional travel patterns, the development of land use plans on a regional scale, the projection of a highway plan for the future, the reactions of officials and residents to the preliminary concepts, and finally the design and engineering talent that have been brought to bear through RTD and its consultants on the transportation services and technologies that are available today or planned for the future.

RTD has recommended both the bus in its most advanced state today, and an imaginative rapid transit system that will meet the desires of residents for convenient, comfortable, safe and modern transportation service for many years to come. The recommended plan consists of three levels of service—local, urban and regional. The objectives of these service levels and the choice of technology to activate them are outlined in the following chapters together with their specific application to routes within the Regional Transportation District.

Regional Bus

Express Bus



Local Bus

Bus Shelter

PRT

PRT Station

Park and Ride

3

Decision for Rapid Transit

A number of considerations led RTD to decide what forms of transit should be included in the regional plan:

- If the transit system is to be an effective alternative to the automobile, it must have the capacity to transport people where they want to go.
- Costs for construction and operation of the system must be acceptable.
- Because residents of this region have not had the opportunity to develop the "transit habit," they are automobile-oriented. The system must offer a high level of service to compete with the comfort and convenience of the automobile.

Several modes of transit were available for consideration. These included conventional railroad trains, modern rapid transit train systems such as the BART system in San Francisco, new transit technologies, various forms of buses, and others.

Why Not an All Bus System?

An all bus system would have the advantage of low capital costs, but studies showed that over a period of years, the all bus system would actually cost more than a combination of bus and rapid transit. The reason for this is primarily the higher per mile operating costs of all bus systems compared to modern rapid transit systems.

In addition, because buses operating on streets and highways cannot move any faster than other traffic, an all bus system would not offer an advantage of speed over the auto. Removing buses from normal traffic by constructing exclusive busways would be an unacceptably expensive solution to this problem.

A third disadvantage to the all bus system is one of capacity. While buses can provide adequate capacity and flexibility of routes to serve many parts of the region, buses just could not provide adequate service at an acceptable cost on routes where traffic is heaviest.

Finally, because buses are flexible in routing and thus not as permanent in their commitment to serve an area, an all bus system would not support the creation of better land use patterns in the region—a major RTD objective. For all these reasons—cost, low speed, and capacity limitations—the all bus system would not satisfy the District's long range transportation needs.

Why Not All Rapid Transit?

While an all rapid transit system could provide a high level of service with speed and capacity not found in an all bus system, construction costs would be unacceptable. Construction of tracks or guideways, stations and other rapid transit facilities to serve the entire region would not only be prohibitively expensive, but also would be an unnecessary expenditure in areas where transportation needs are not great enough to warrant these high costs. In most of these areas the bus, with its flexibility, is the appropriate answer.

Studies showed that the projected heavily traveled routes of the region are the only locations where the speed and capacity of rapid transit are needed and the only locations where use of the system would be great enough to make the expenditure worthwhile.

Thus, an all rapid transit system was unacceptable, and so RTD proposed a combination of bus and rapid transit for the regional system, to take advantage of the best features of both types of service.

What Kind of Rapid Transit?

Once the decision had been made to use rapid transit on the region's most heavily traveled routes, several different kinds of rapid transit were considered. RTD further assessed traffic volumes for each route and each station on a possible system during the day's rush hours and in off-peak hours when fewer people could be expected to use the system. Computer analysis, conducted through the Joint Regional Planning Program, provided predictions on how many passengers could be expected to use each line of the system at any hour of the day. These estimates were carried through to the year 2000.

Conventional railroad trains were rejected almost immediately because they lack the flexibility and convenience needed for the RTD system. Results of the studies showed that either a modern rapid transit train or a personal rapid transit (PRT) system could accommodate enough passengers to meet the region's needs.

Personal Rapid Transit (PRT) is a system of vehicles which are smaller than rapid transit trains. It is a new technology being examined and tested by world planners as a modern solution to urban transportation problems. After careful consideration PRT was chosen as the best solution to rapid transit needs in the Regional Transportation District, because PRT could serve passengers most attractively, efficiently, and economically.

What Is PRT?

Personal Rapid Transit (PRT) vehicles are small cars operating at a high frequency on a track or guideway at ground level, underground or overhead. Most of the track or guideway proposed by RTD is overhead or aerial. A short section in downtown Denver would be subway.

No PRT drivers are necessary, because the vehicles are controlled automatically by a control system in the main operations center. The entire system, however, is monitored by people in the operations center and in each station who can take action when necessary to meet special situations.

The cars are powered by electricity drawn from the guideway on which they travel. Maximum speeds are 30 to 40 miles per hour. The vehicles do not have an exhaust that contributes to air pollution.

PRT vehicles currently being tested and operated by commercial companies vary in technology. Four examples were demonstrated last June by the Federal Department of Transportation at TRANSPO '72 in Washington, D. C. Two of these vehicles are rubber-tired, one is suspended from a slender overhead track and the fourth is supported on its track by a cushion of air. Included in the demonstration of each vehicle was a control system which could be applied to an operational situation.

One of the world's first operational PRT systems is now in the test phase at Morgantown, West Virginia, where 3.5 miles are being built to connect the separate campuses of the University of West Virginia, a sports center, and the city's business district. Funded through the U. S. Department of Transportation (DOT), the first two miles of the system were dedicated in October, 1972, and the full system is scheduled to be operational by 1974.

A second PRT demonstration project was awarded to Denver through RTD in October, 1972. DOT granted $11 million for construction of the first mile of a five-mile system to run through downtown Denver. The first mile is intended to test and check out the system while construction continues on the remaining four miles.

A 12-mile system is being installed at the new Dallas-Fort Worth Airport to move passengers, employees, baggage, mail and trash automatically throughout the complex. The system will be completed sometime in mid-1973.

Inside PRT Cars

Because each PRT car carries fewer passengers than most forms of rapid transit, the cars are smaller and more personal in appearance and conveniences. The cars have carpeted floors and comfortable, upholstered

seats. Lighting is pleasantly toned, making it easy for passengers to read. A climate control system provides for air conditioning or comfortable heating within the cars. Large tinted windows offer panoramic views. The design emphasizes ease of cleaning and materials that will maintain their attractiveness. But to maintain a high level of appearance, the present plans call for each vehicle to be cleaned inside and out twice daily.

How Does PRT Operate?

A PRT system's small cars will sometimes enable passengers to travel alone or only with acquaintances to their destination as they would in their automobiles.

PRT has the capability of operating like a horizontal elevator. Inside stations along the route, passengers can push a button to indicate their destination. If a car is not already waiting, it will arrive within seconds to take them straight to their destination usually without transfers or intermediate stops. Although the cars are small, many passengers can travel along a route because of the short time intervals between vehicles. While rapid transit trains require at least 90 seconds between vehicles, the first PRT cars on the system would probably be spaced every 15 seconds (or every 660 feet, at 30 mph). Analysis has indicated that PRT cars can be safely operated at 7½ second intervals. As travel needs increase there will be room for more cars to operate on the system.

Few Stops or Transfers

Passengers usually will not have to stop or transfer at other stations during a PRT trip. All stations are located off the main track, so that PRT cars can pass the station even if cars ahead have stopped. Because of this, as the need for service increases, PRT stations can be added to the system without affecting service. In addition, if cargo-hauling capabilities are developed, vehicles also will be able to stop at cargo stations for loading and unloading of cargo without slowing passenger travel.

PRT vehicles can be programmed to take the fastest route between two points. For example, one possible route between points may go through the downtown area. If the control system tells the car that the downtown area is congested, it will avoid that route and choose another that is not as busy.

Two Kinds of Service

PRT has the unique capability of serving individual trips. That is, unlike other transit services, PRT can sometimes take one person exactly where he wants to go in his own private vehicle. The individual pushing the button determines his own destination.

But if PRT service were limited to meeting individual needs, it could never be practical in rush hours when many people use the system. In those hours when traffic volume is heavy, PRT serves groups of people rather than individuals. It does this by anticipating travel needs before passengers arrive at the station. This reduces their waiting time and takes maximum advantage of the system's capacity and its more personalized service. Even during rush hours, however, cars will not have to stop at every station.

The PRT control system will "know" when and where cars are needed on the system during certain times of the day. At first its "knowledge" will be based on the studies which enabled RTD to determine how many people would be traveling certain routes during certain hours. But as the system is used and a certain number of people appear consistently at a station, the system will "learn from experience" to anticipate those people. As travel patterns change, the computer will automatically react to accommodate them.

This capability is necessary because there are certain hours of the day, rush hours for example, when many people are traveling the same routes. Passengers will have much shorter waiting periods for cars on a system which can anticipate their travel needs ahead of their arrival at the station. They won't have to wait for a train scheduled to arrive at a specific time as on some systems. Instead, a car will either be waiting for them or on the way to pick them up. During rush hours, they may have to stop at a couple of stations to fill their car to capacity or to let some passengers off. But they won't have to stop at every station as on some systems.

Special needs for service can be programmed into the control system at any time. For example, PRT cars can be sent to serve heavy traffic to and from Mile High Stadium before and after a sporting event. Cars can automatically be sent from a light traffic area to serve a heavy traffic area without disrupting service elsewhere on the system. This flexibility is a great advantage over trains which must always arrive and depart on a set schedule.

The level of service provided in a PRT system—as is the case in all public transportation systems—can be increased, but not without increasing the cost of the service. A good balance of service and cost meets the desires of PRT passengers for transportation and still makes possible a system that pays for its operating expenses at a fare that is reasonable.

PRT Vehicle's Day

A "day in the life" of a PRT vehicle could begin in one of the two storage and maintenance facilities planned for the system.

As it leaves the southern storage facility, the PRT vehicle comes under the control of the control system at the operations center. It also can be seen visually on a screen watched by the person assigned to monitor that section of the PRT network.

The vehicle moves north along the route paralleling Santa Fe Drive. It stops at the Mississippi Avenue station in response to two "graveyard" workers returning home after their shift. They have indicated as their destination the Havana Street station in Aurora and the PRT vehicle takes them there non-stop.

The PRT vehicle leaves the station and, empty, it heads east and then south to the Aurora station at I-225 and Alameda where it stops at the platform with a number of other cars. In a short while, the first of the daytime workers—a group of six secretaries—arrives at the station and leaves aboard the vehicle.

A lighted sign has indicated to the secretaries that the vehicle will stop at the Court Place and Curtis Street stations. As the vehicle travels west on Colfax, it is directed to stop for six more passengers at the Quebec Street station headed for the same two destinations.

Minutes later after the last of its passengers depart at Curtis Street, the PRT vehicle heads north toward Broomfield with two salesmen who had spent the night at a Skyline hotel. The morning rush hour is already filling vehicles that had been waiting at the Broomfield station. Before more than a few minutes have passed after the departure of the last vehicle at the Broomfield station, the PRT vehicle arrives, lets off its two salesmen, picks up 12 new riders and this time heads south to the Federal Center.

The process repeats itself until about 9:30 that morning when the PRT vehicle returns to a storage and maintenance facility for a complete cleaning inside and out. By late morning it is back in service taking shoppers to stores and lunch.

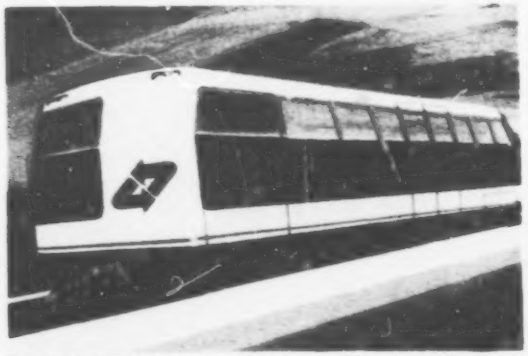
The PRT vehicle moves about the network, as it did that morning, to meet requirements of passengers. During the late afternoon, it begins returning riders from work to home. It is back in the maintenance facility for another cleaning in the early evening hours and then returns to the network to meet other trips, such as to and from evening cultural or sports events. Most of the early morning hours are spent waiting in a station for riders before the rush hour begins the day again.

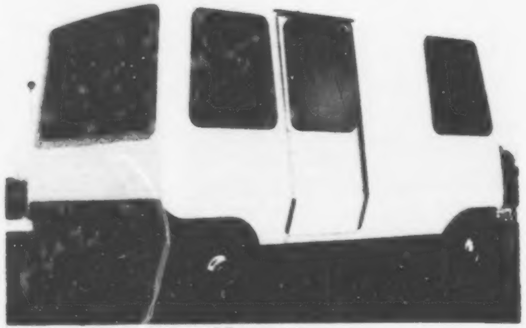
All PRT vehicles are coordinated by the control system that "knows" where and when transportation service is needed on the PRT network. Overall control is provided by personnel at the operations center and in each station who make certain the system is functioning as it should. These personnel can override the computer and take control of any vehicle on the system at any time.

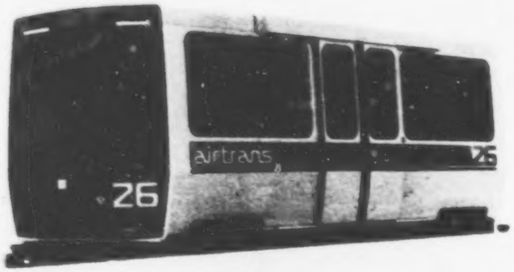
Why PRT?

Personal rapid transit (PRT) offers the citizens of RTD several advantages over the rapid transit train:

RTD's seven-county area does not have the density of population or the volume of travel even on its most heavily traveled routes to warrant use of vehicles with high seating capacity. RTD's transportation needs are more evenly dispersed throughout the region than in most metropolitan areas. Rapid transit train systems, such as BART in San Francisco,


Ford ACT, Transpo '72


Boeing Company, Morgantown



LTV; Air Trans, Dallas-Fort Worth Airport use vehicles which seat 72 passengers, with vehicles coupled together in two-to-ten-car trains carrying as many as 700 passengers.

- High capacity rail systems generate higher population densities than might be desired by some communities. Lower capacity PRT systems will not encourage very high density and will at the same time provide a community with the convenience of rapid transit service.

- While a rapid transit system might prove more efficient during rush hours, it would be less efficient for RTD during most of the day. Studies and projections of transit use indicated that if RTD were to choose a rapid transit train system, the vehicles would operate with empty seats much of the time, making the system more expensive and less efficient to operate than PRT. This is in spite of the fact that rapid transit train systems have a lower cost per seat per mile.

- PRT's smaller vehicles are more closely tailored to passengers' needs. That is, the system has the capability of supplying an individual with a car almost immediately to take him where he wants to go. Even during rush hours, it can anticipate his trip ahead of time. He won't have to wait for a train to arrive as scheduled.

- A PRT system can be of sufficient size to meet the region's transportation needs, while offering a more personalized service on smaller vehicles and the capability to travel non-stop between any two points.

- Waiting times will be less, because the PRT system "learns" from experience. It can send cars to various points in the system after "learning" when and where those cars will be needed.

- As travel patterns change from day to day, the control system will change its program to accommodate new patterns.

- Unlike rapid transit train systems, PRT stations will be located off the main line. PRT vehicles stopping at a station will not block the path of following vehicles.

- PRT facilities, including the guideway on which the vehicles run, are smaller than those required for larger rapid transit train vehicles. This means lower construction costs and less interference with the surrounding environment.

- Overall costs including stations and vehicles are $10-$15 million per mile for PRT systems and $15-$30 million for most rapid transit train systems.

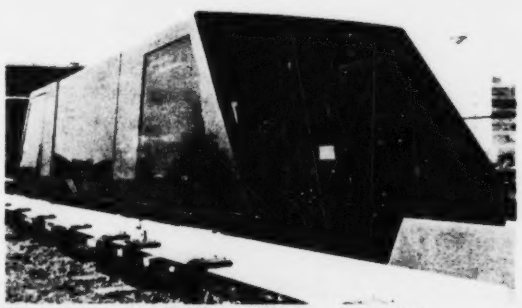
Other PRT Advantages

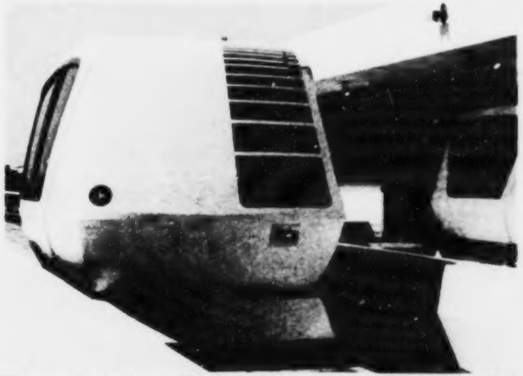
- Although cars are small and service is personalized, the PRT system can handle the District's rush hour traffic. On one lane of guideway (going in one direction) 6,000 passengers can pass any point on the system in an hour. This is the same number of passengers which travel by auto in three lanes of highway traffic.

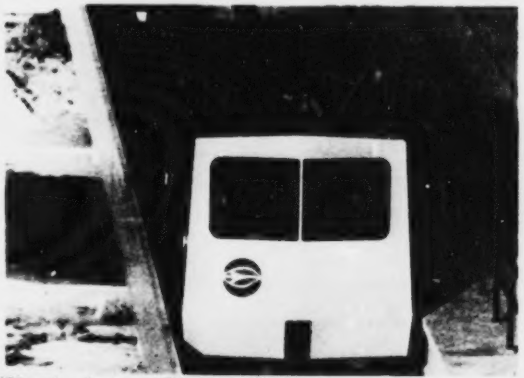
- PRT requires far less space than streets, highways, or rapid transit trains. Freeways involve a width of 200 to 500 feet. A two-way PRT guideway has a width of about 20 feet.

- Guideways can be constructed overhead to conserve space for better land use. Areas below these guideways can be landscaped for parkways and bicycle routes, saving space and contributing to the natural beauty of a city.

- In downtown areas, the system and its stations can be incorporated within new building construction, providing easy access


Messerschmitt-Bolkow-Blohm, Munich


Transportation Technology, Inc., Transpo '72


Westinghouse Corporation, Tampa Airport

to offices and stores.

- The PRT system is carefully designed to accommodate the elderly and handicapped. Stations include elevators between levels and passenger loading platforms will be level with PRT vehicles for easy movement. PRT vehicles can be designed to accommodate wheelchairs.

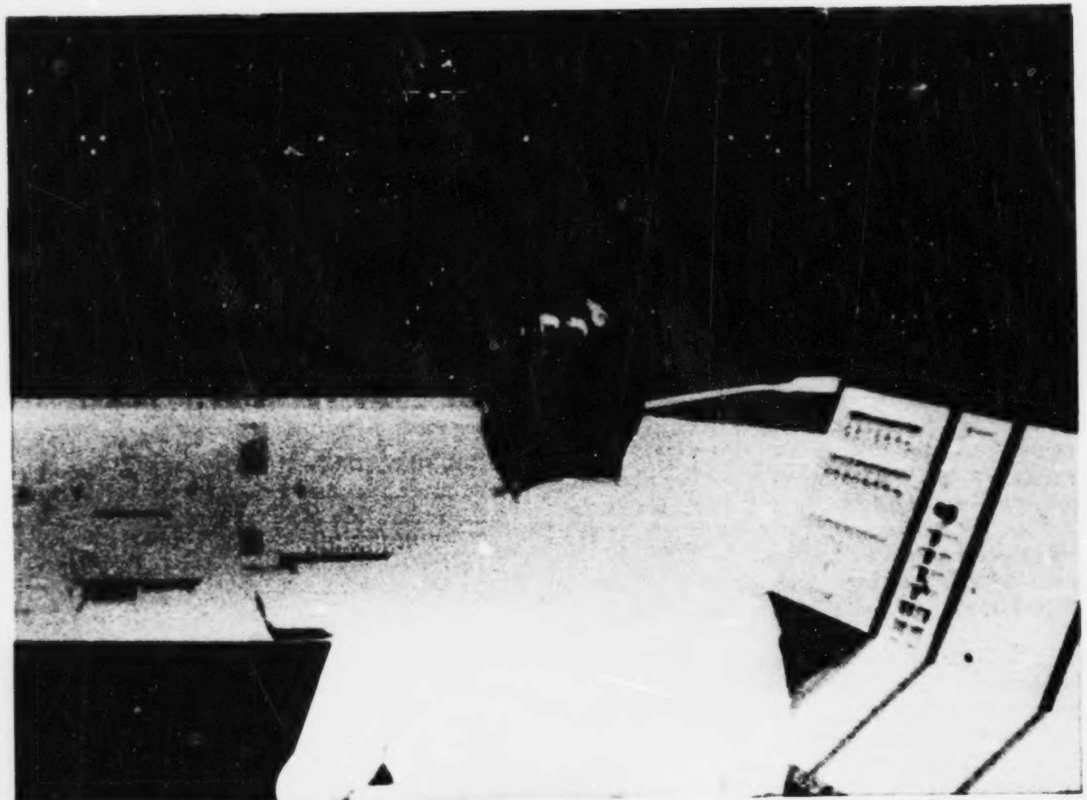
PRT Is Best Answer

RTD recommends PRT over the rapid transit train because its higher level of personalized service, lower overall costs and its greater flexibility will offer the District the best solution to its very specific transportation needs.

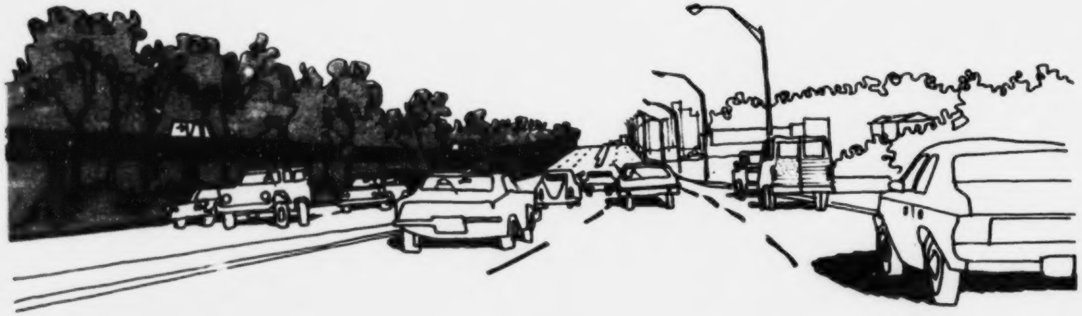
RTD has not chosen a specific type of vehicle. Only its performance characteristics, feasibility and preliminary cost estimates have been determined. Later, RTD will choose a specific type of hardware with the best balance of service, safety, reliability and cost to meet the needs of the region.

Of course, there are potentially greater technical problems in selecting a new technology over an older one. But even this is minimized as RTD, the Federal government, and private industry continue to study and evaluate PRT systems currently in operation. Carefully phased implementation together with constant analysis of operations will further ensure the system's reliability.

A far greater risk to the people of the District is to adopt a service which fails to attract riders. Only if people are willing to use transit for some of their trips can the social, economic and environmental benefits of balanced transportation be realized.



Monitoring PRT Control System



PRT Guideway in Linear Park

Buses Offer Service Flexibility

As discussed earlier, PRT service should be limited to heavily-traveled routes to justify the system's construction costs. Bus service is less expensive to initiate than PRT or any rapid transit system with a guideway or track. Bus routes are more flexible than PRT routes. As new demands for service arise, buses are an immediate and flexible solution to transportation needs.

RTD proposes that a metropolitan bus system offering various levels of transit services would be most compatible with the PRT system.

Express Bus Service

Express bus service is a network of medium to high speed transportation throughout the metropolitan area. RTD recommends express buses principally for direct service, but wherever speed or comfort are not sacrificed express buses will also stop at major employment, housing or shopping centers along the route. Express bus stops will be located within 2½ miles of almost every residence with buses stopping every 10 to 15 minutes.

Express buses will be standard size, similar in technology to the more modern Denver Metro Transit buses.

Express bus service will also be of two types. First express buses will supplement local service on certain routes by providing higher speed service with fewer stops. Second, the express bus network will link the communities and major traffic generators with faster, more frequent service than provided by local buses. RTD recommends express buses principally for direct service.

Local Bus Service

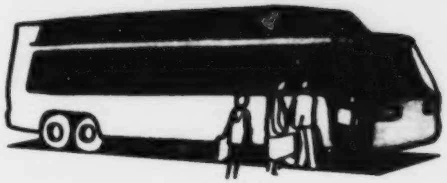
Local bus service is designed to expand available service to the urban areas. Because local buses will stop within a quarter mile of most residential homes, they will be a viable alternative to the automobile and will increase access to various points within the community. Buses will stop every 10 minutes during peak hours and the maximum length of ride will be 15 minutes.

Local buses, probably smaller in size than the express buses, will serve as both a feeder-collector service to PRT and express bus lines and provide short, direct trips in some areas.

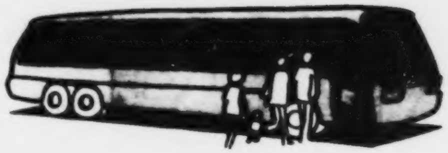
Demand-responsive bus systems, now in use in some cities, have great potential for local service. For service on these Dial-A-Bus systems, a passenger telephones his trip request to a dispatching center. A bus picks him up at his point of origin and delivers him to his specific destination. The buses operate much like taxis without fixed routes or schedules. By grouping passengers together who have origins and destinations in the same general areas, a service comparable to a taxi is provided at a lower cost.

There are three alternatives for demand-responsive systems:

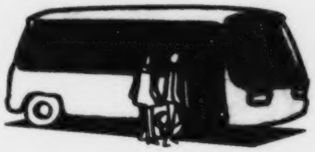
> *Route deviation service.* The vehicle follows a basic fixed route, but deviates from it to offer door-to-door service upon request.
>
> *Many-to-one service.* The service involves many origins, but only one destination or vice versa. Collection might be in a suburban area to serve a rapid transit station.
>
> *Many-to-many service.* Trips are provided from many origins to many destinations. Dispatching centers use



Regional Bus



Express Bus



Local Bus

both manual and computer techniques for converting telephone requests into dispatch commands.

Risk in implementing demand-responsive systems is not in the technology, which appears to be adequate, but in the operating cost estimates as related to use of the system according to various schemes of operation.

Regional Bus Service

Regional bus service will link urban areas and smaller communities. Routes will use the most appropriate highway facilities to minimize travel times between these areas. Connections to local bus and PRT will be available at key locations to provide convenient access to all parts of the region.

Because regional buses will travel longer distances, the buses will be especially equipped for passenger comfort and capable of higher speeds.

New Bus Technology

In August of 1972 the Department of Transportation (DOT) dedicated $24 million to a program called Transbus to improve transit bus technology. This was the first time that significant Federal funds had been granted for bus improvements.

The grant was received by Booz, Allen/Applied Research of Bethesda, Maryland, who immediately awarded major subcontracts for hardware and testing in the Transbus program to AM General Corporation of Wayne, Michigan; General Motors—Truck and Coach Division of Pontiac, Michigan; and Rohr Industries of Chula Vista, California.

Each of the subcontractors is building three buses for government evaluation. The best design will be selected as the standard urban bus design for federally-assisted transit systems.

Design Features

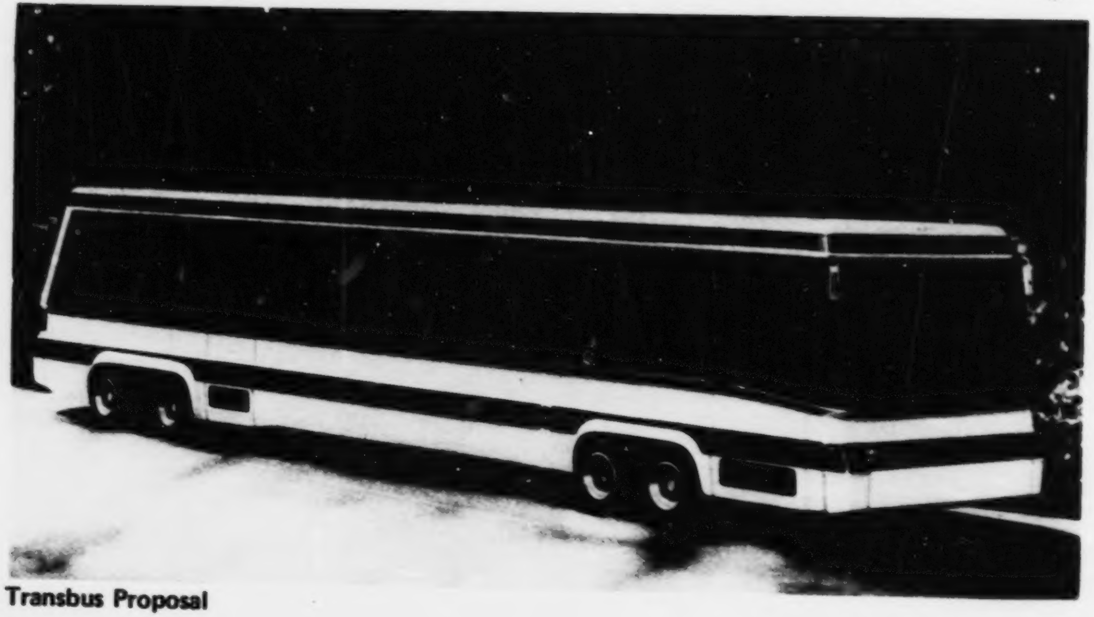
The new buses will be designed for greater passenger comfort, convenience and safety. Buses will have wide padded seats, increased knee room, large tinted windows, improved air conditioning and heating mechanisms, and a smooth ride competitive with the best of automobiles.

Evaluation of the new buses will begin in mid-1973 in several cities, with the final selection of the best design in 1974. After a pilot production and vehicle test program is completed, full scale production of the final bus design will begin.

A second research program currently being sponsored by the National Transportation Center is known as the "Superbus" project. Superbus is an experimentation program of double-deck coaches and high-capacity articulated buses. Articulated or tandem buses are long buses with a flexible center portion allowing for easier turns around corners.

The new buses will be nearly one foot lower than buses now in operation and designs will be highly advanced. Noise levels on the outside will be reduced by more than 50 percent, approaching that of an automobile. Noise levels on the inside are expected to be 75 percent lower than those on current buses, producing a marked improvement in interior comfort. The buses will also have numerous features to reduce repair and service costs.

Buses will be equipped with two-way communications capability. This will permit central control to reroute buses in the event of emergen-



Transbus Proposal

cies or street blockages. It will also allow the drivers to contact central control in case of vehicle trouble, passenger illness or other problems. A hidden signal device, when activated, will notify central control of any criminal activity on the vehicle.

Special provisions will be made to overcome difficulties faced by handicapped persons in using present day buses. These include provisions for wheelchairs, audio and visual signals and instructions for passengers, and assist mechanisms for entrance and exit. In a DOT bus demonstration project in Haddonfield, New Jersey, bus rear doors are hinged at the bottom enabling them to convert to ramps, for easy entrance and exit of wheelchairs. Further provisions for handicapped persons are currently being tested in the DOT Transbus program.

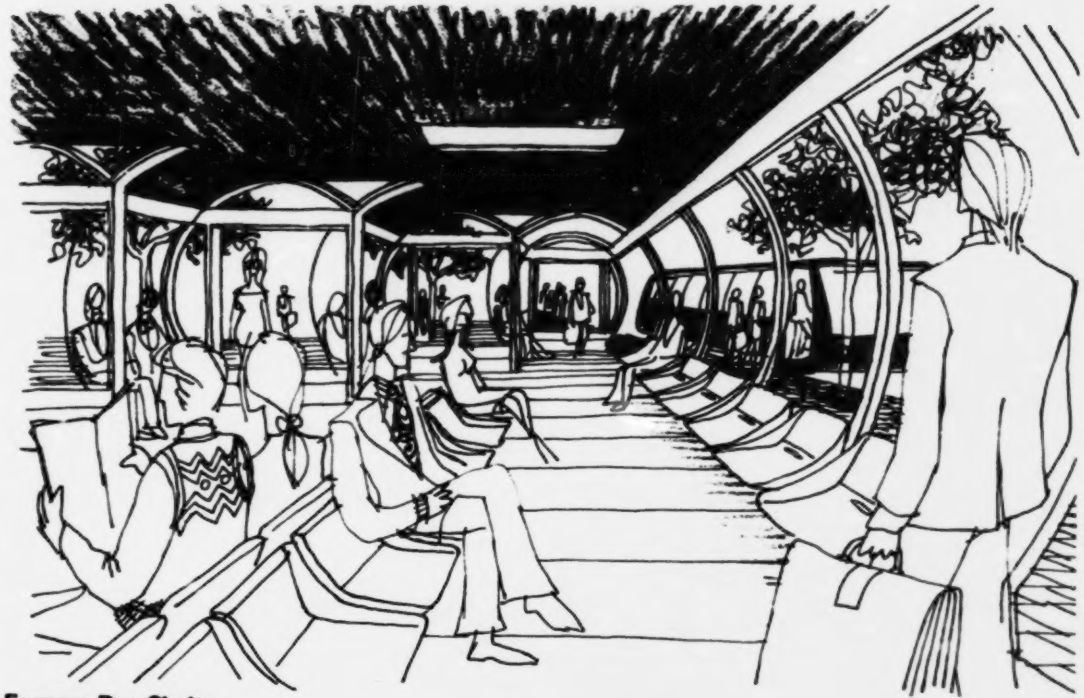
Reduced Pollution Emissions

Continuing efforts are underway to reduce air pollution caused by buses. The newest buses purchased by Denver Metro Transit are equipped with a special Environmental Improvement Package which is designed to further reduce toxic emissions and cut down on hydrocarbons and particulates.

Initial bus models will be powered with improved high performance diesel engines which are virtually smokeless and odorless. The basic bus design will be capable of accepting other advanced power systems such as gas turbines and steam engines. At least three manufacturers are currently developing steam-powered buses and one is in the testing phase. For short routes, electric buses may prove practical. Now under development, these small coaches leave sufficient battery power to make several trips between quick charges.

What Will It Be Like to Use the System?

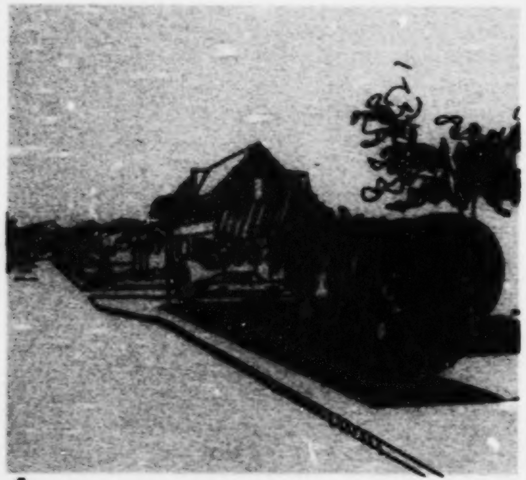
The modern RTD transit system will offer fast, convenient travel in automobile comfort. But the greatest advantage is that once passengers choose a destination by boarding a bus or PRT car, they need give little added thought to how they are going to reach that destination. Transit does it for them.



Express Bus Shelter

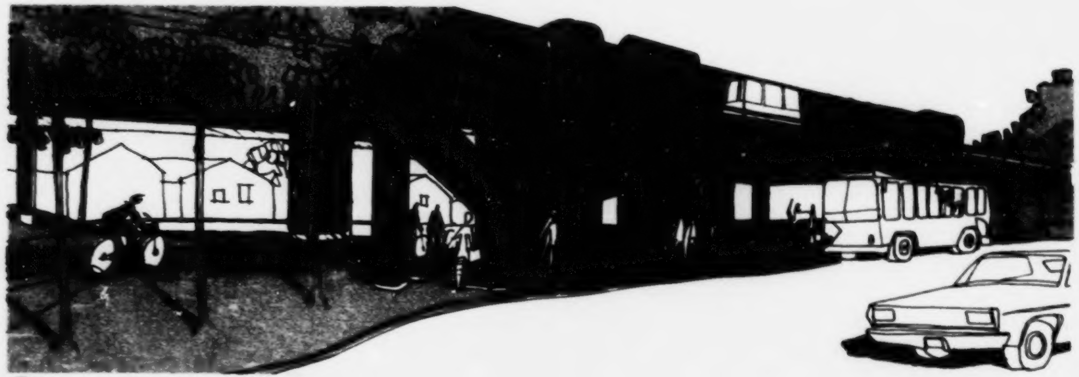
Following are some examples of what it might be like to use the system for various types of trips.

Shopping Trip



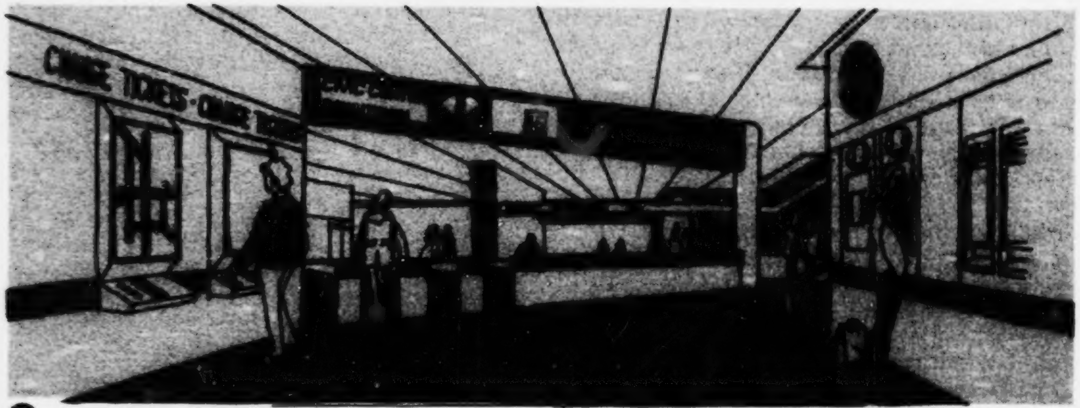
1

A lady who lives in Arvada decides to go shopping on a weekday morning. It takes her only a few minutes to walk about two blocks from her home to the nearest local bus shelter.



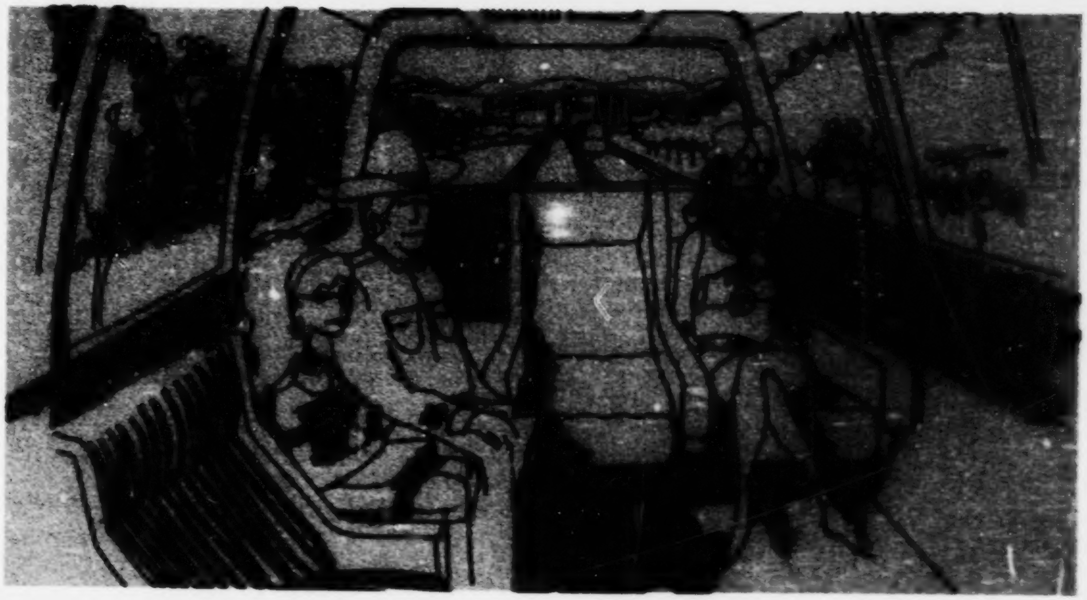
2

After a short bus ride she arrives at the Arvada PRT station. In the station, she inserts a dollar bill in a money-changer since she doesn't have the correct change to purchase a ticket. She pushes a button to indicate that she wants a ticket to the Villa Italia Shopping Center and then places the exact amount for the ticket in the dispensing machine slot. The sale is made. The machine releases her ticket.



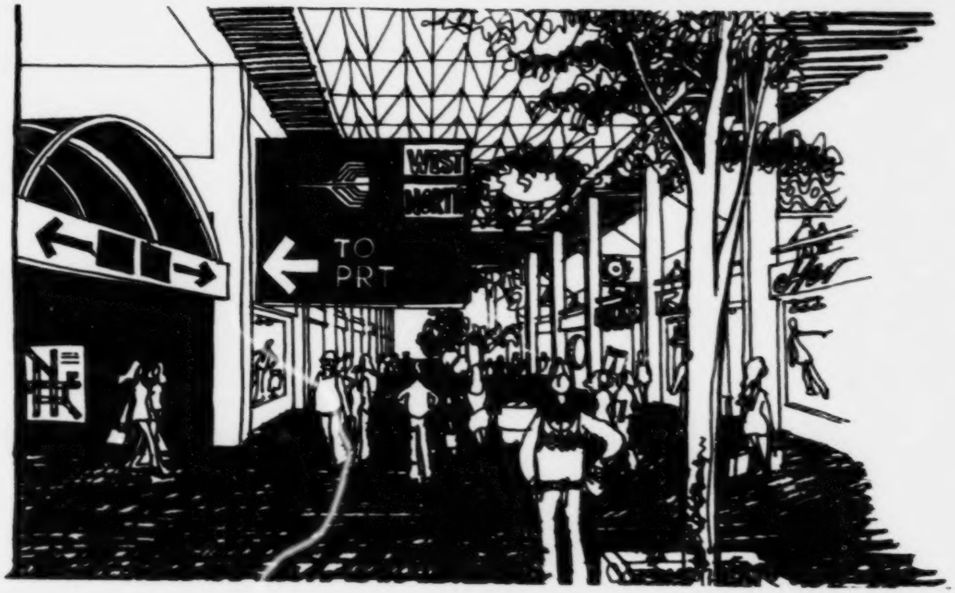
3

She then goes to the fare collection gate, used for both entrance and exit. An arrow on the ticket indicates how to insert the ticket in a slot to the right of the gate. Because the ticket is magnetically encoded, it can be read by the machine to affirm its validity. The ticket is immediately returned to her. The gate opens and she passes through. She boards an escalator moving up toward the PRT platform.



4

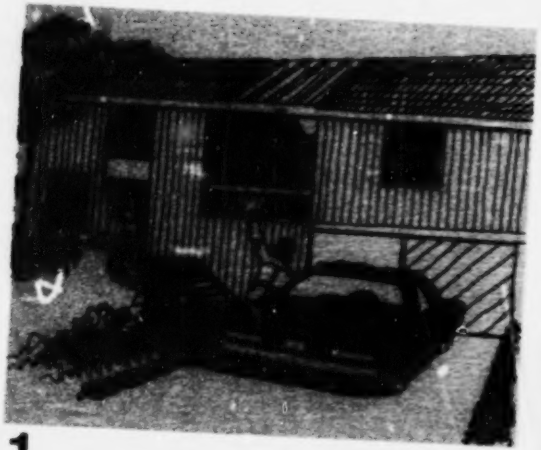
There she pushes a button reading Villa Italia—the station to which she is traveling. A lighted sign near a waiting PRT car flashes "Villa Italia." She boards the car and heads toward her destination. Because she is traveling in an off-peak hour, PRT can offer her its highest form of personalized service. That is, a car is waiting to take her directly to her destination without stops or transfers.



5

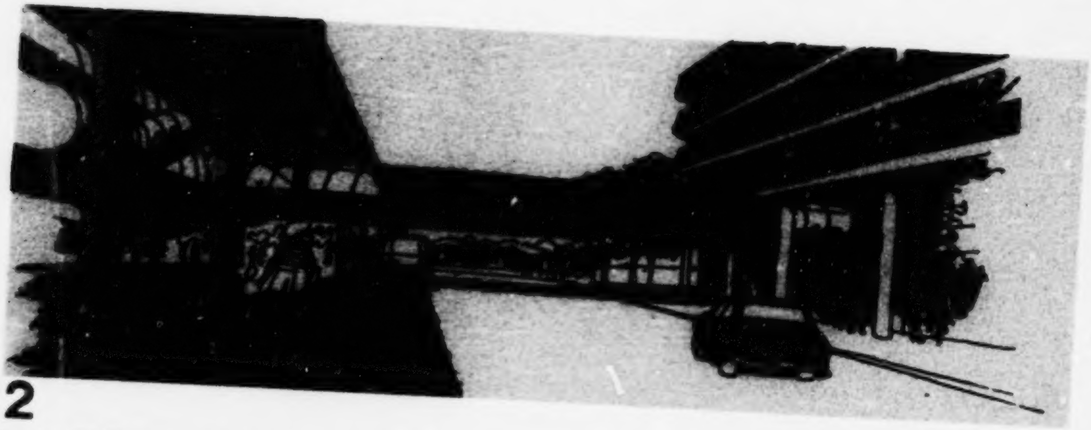
She arrives at the Villa Italia shopping center station, where she again passes through a fare collection gate using her ticket. Because the ticket has no remaining rides, it is retained by the machine as she passes through the gate. At the shopping center she may take a local shuttle bus to the store of her choice.

Work Trip



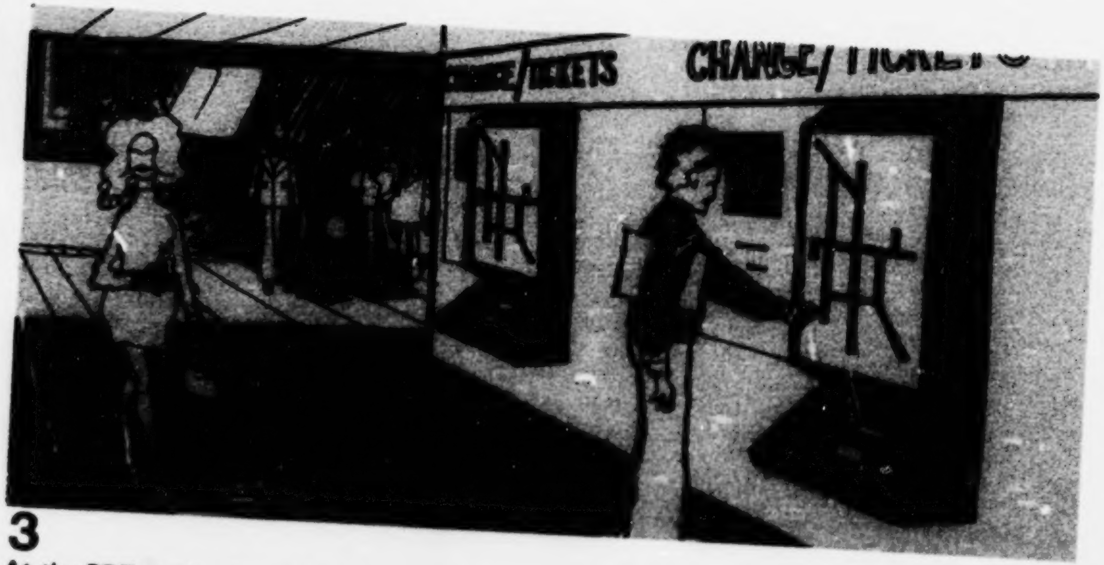
1

As many people will do, a Northglenn man leaves his home for work by car, driving to a transportation center located along Interstate 25. There he can park his car all day and take PRT downtown or to a variety of other destinations. He can also leave his car for servicing at a nearby service station or shop after work before taking his car out of the service garage to travel home.



2

In the PRT station he inserts a five-dollar bill into a vending machine slot to purchase a five-dollar ticket which will pay for a number of trips to and from work on PRT. He inserts the ticket in the fare collection gate and as he passes through the ticket is returned to him.

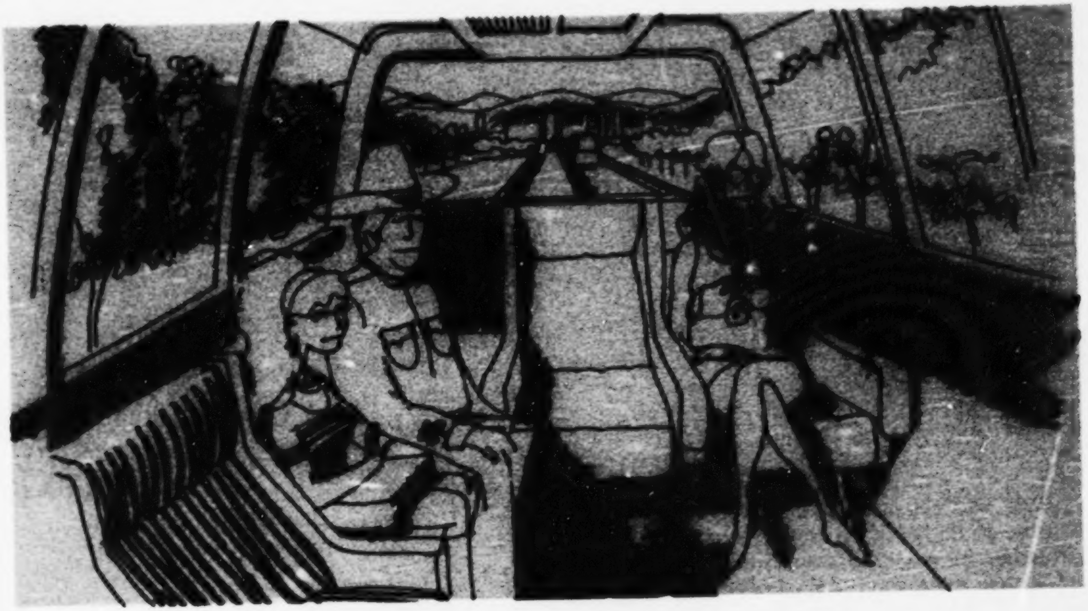


3

At the PRT station he pushes a button for a car to a downtown station. A car has just arrived at the platform with a sign indicating the name of his station destination and one other in the downtown area. He boards that vehicle along with several other people, but the PRT car is not filled to its all-seated capacity.

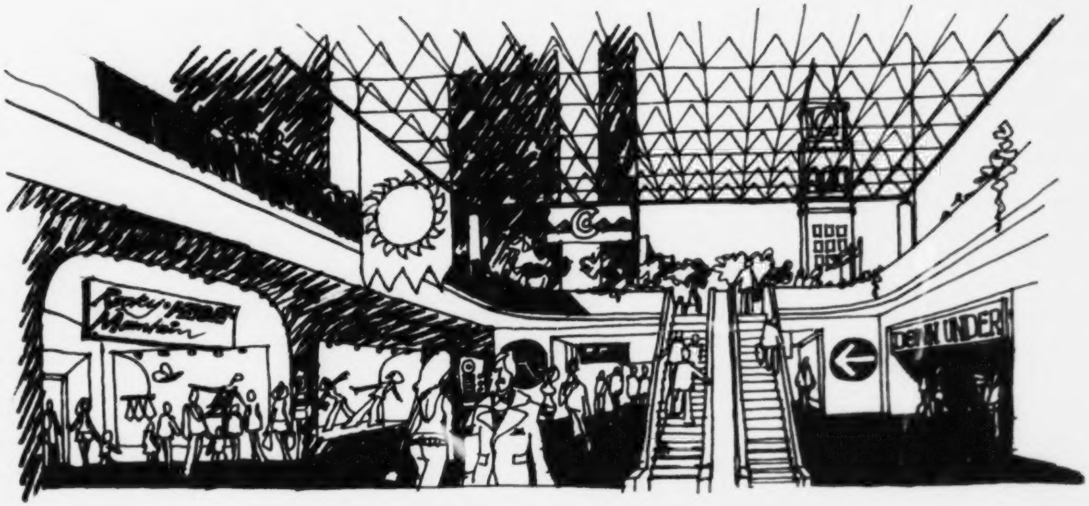
4

As the trip begins, the Northglenn resident and several other passengers read morning newspapers purchased from vending machines in the station. Because it is rush hour and the vehicles should be used to capacity, the car also stops in Thornton. Several other passengers board the car until all seats are taken. Then the PRT car continues directly, non-stop, toward the two downtown Denver stations where all of its passengers get off.

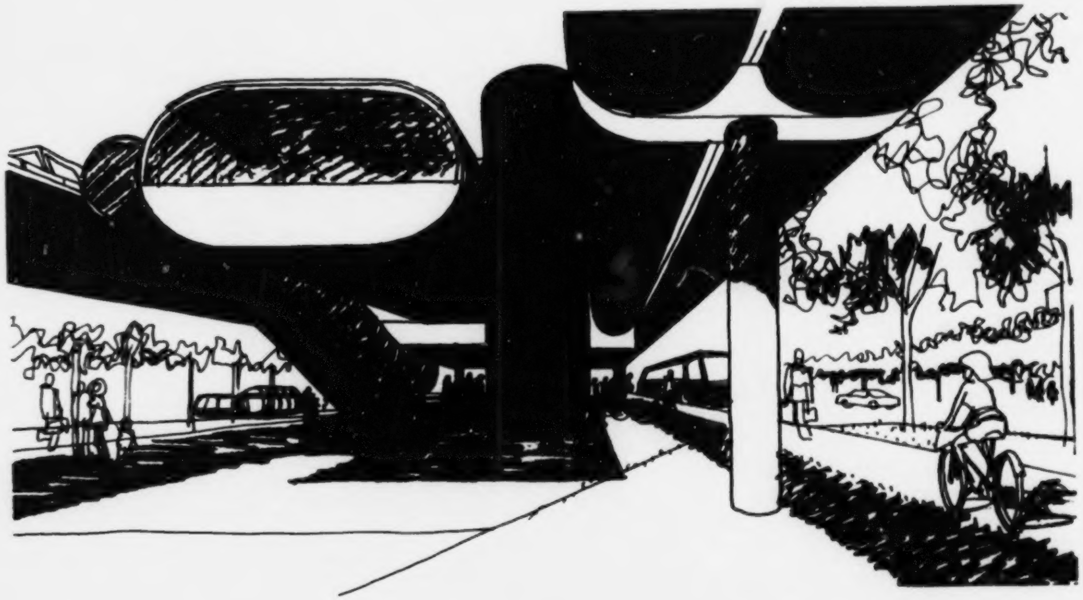


5

After arriving in downtown Denver, the Northglenn man again passes through a fare collection gate using his ticket. The machine at the gate subtracts the ride from the five-dollar ticket and returns the ticket to him. As he passes through the concourse level of the station on his way to his downtown office, he places the ticket in the credit card section of his wallet where it will be safe until he needs it for his return trip home that evening.

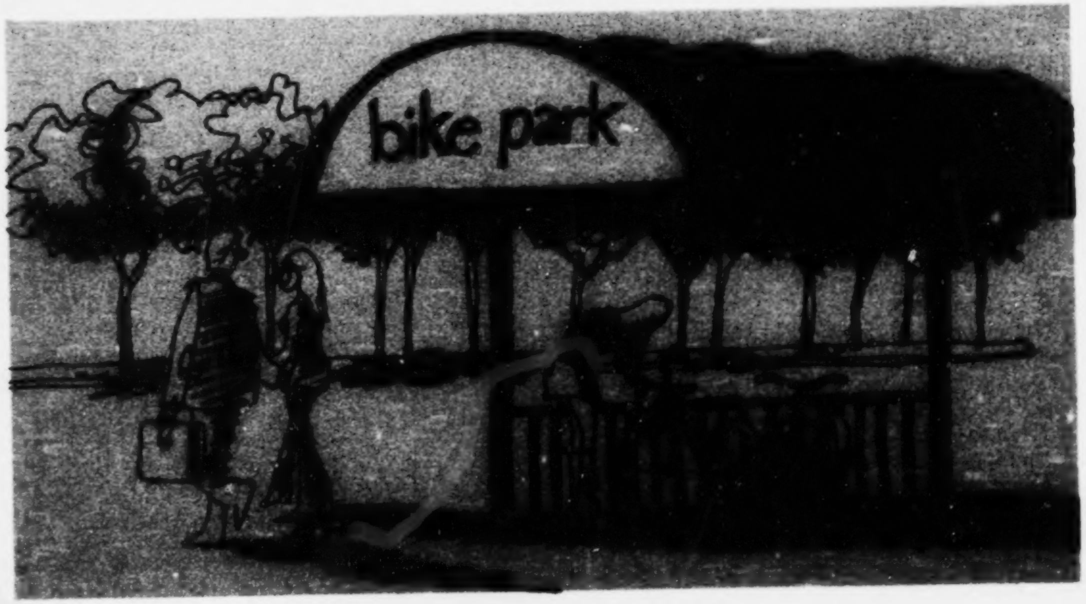


Recreation Trip



1

A Littleton girl decides to spend a Sunday afternoon at the Denver Art Museum. She rides her bicycle along a landscaped path underneath the PRT guideway to the nearest PRT station on Santa Fe Drive.

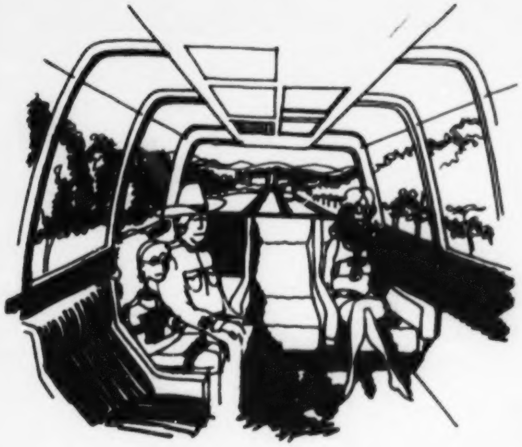


2

She parks her bike and locks it at a rack next to the station entrance. (Eventually on some PRT cars she may be able to take it with her.)

3

After purchasing her ticket at the station concourse, she takes the escalator to the passenger platform, and follows the graphic directions to the waiting PRT vehicle.



4

She boards the PRT vehicle and 18 minutes later arrives at Capitol Station.

5

A short walk across the Civic Center brings her to the Denver Art Museum.

805

4

Developing a Transit System

With levels of service defined as local bus, express bus, regional bus and personal rapid transit, the most demanding job for RTD has been to organize these services into a route system. Each service complements the other and is applied where it can be most effective. The transit system as a whole must also be coordinated with existing and planned highways and with land use plans drawn for the region by representative governments. Finally, these technical decisions must be moderated by the desires of the residents of the District—if the system doesn't serve them, ridership will suffer.

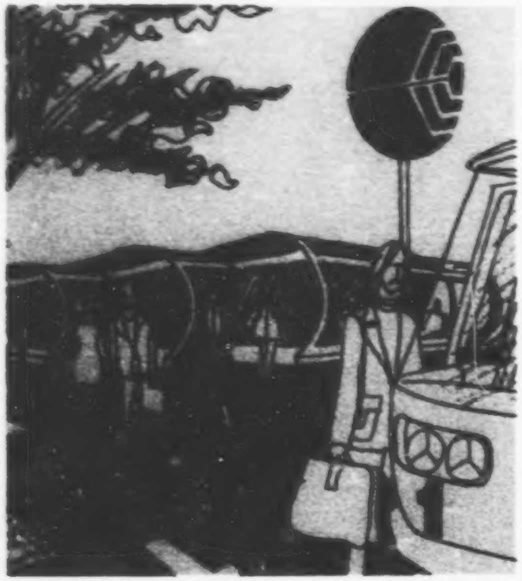
RTD has followed a logical course of action to establish system routing. The first step was the extensive travel patterns survey taken in the District by the Joint Regional Planning Program in which more than 140,000 interviews were conducted to find out where people came from, where they went, the purpose of their trip and how frequently they made it. This information combined with projections of future travel patterns formed the basis for evaluation of preliminary routes.

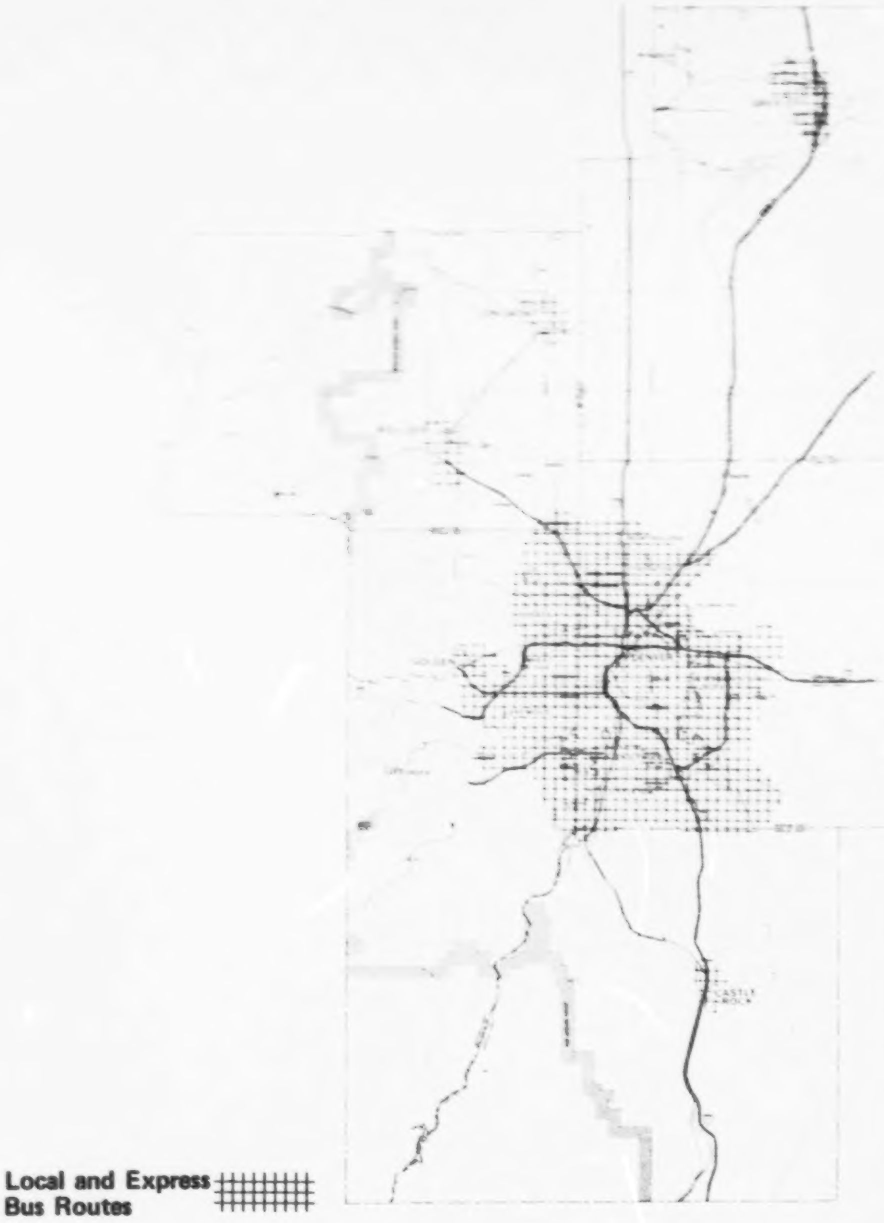
The preliminary routes were then presented to local officials and to residents of the region. The final route selections by RTD for recommendation to the residents of the District represent a compilation of the best technical information available and the suggestions of individuals at meetings throughout the District. The latter process will be repeated in the form of public hearings before RTD settles on a final plan for submittal to the voters later this year.

Local and Express Bus Routes

The routes of the local and express buses that serve intra-urban or even neighborhood circulation demands are the most flexible and thus responsive to the needs of passengers. Because of this flexibility and the coincidence of the two types of service on the same streets and highways in many cases, the accompanying maps do not differentiate between the two. The routes can be modified in response to public desires consistent with capability to provide the service and the passenger volume to support it. As presently mapped, the local bus routes pass within about a quarter mile of the majority of the residents of the RTD.

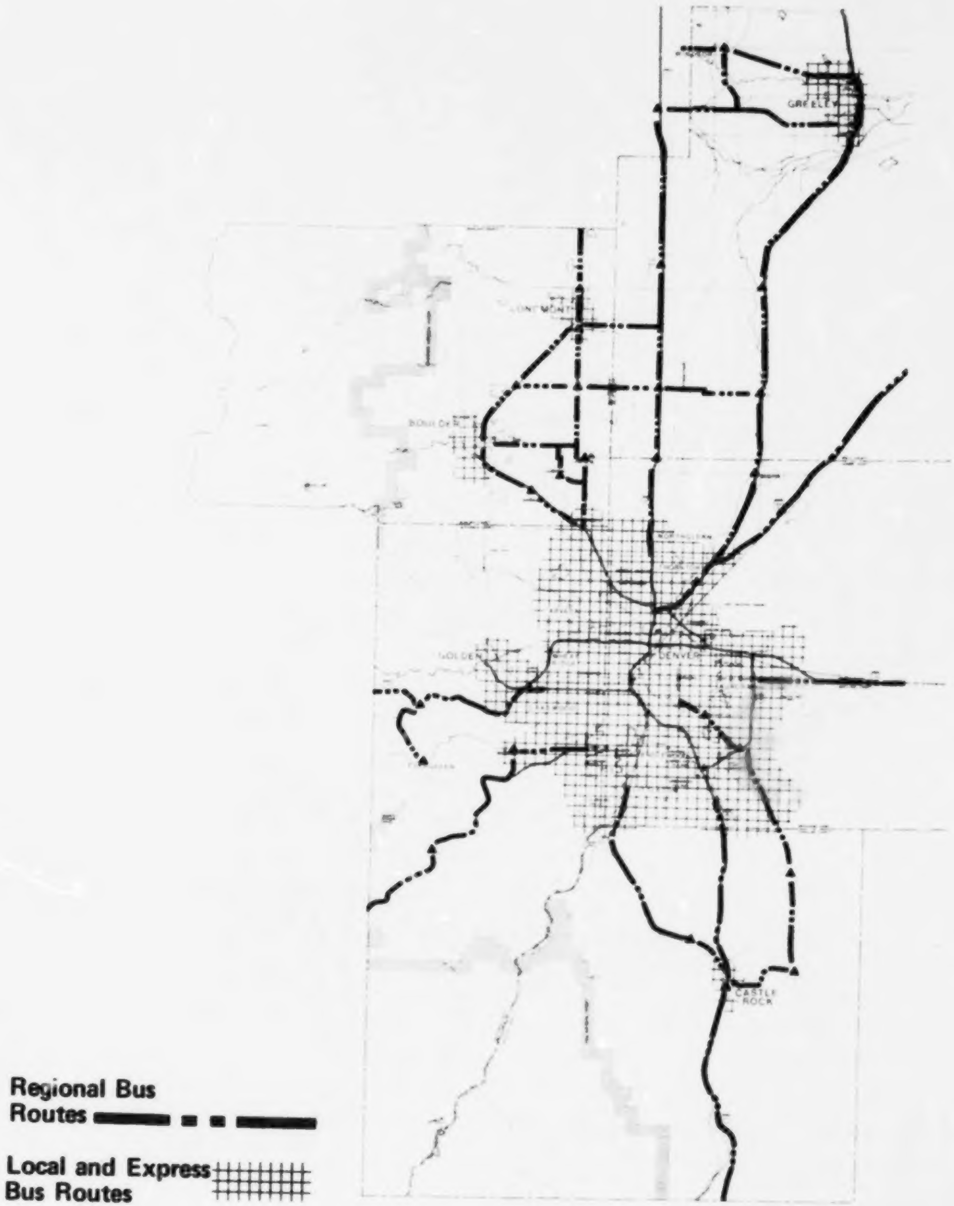
The express buses generally travel from one location to another without any or with very few intermediate stops. They form a network of medium to high speed transportation.




Local and Express Bus Routes ▦
CASTLE ROCK

Regional Bus Routes

The indicated routes for regional bus connections are relatively inflexible since they generally travel the fastest available route between two urban points. The principal flexibility open to transportation planners of regional bus systems is frequency of service, which is dependent on demand. Routes in addition to those indicated can be established where demand grows. In many cases, the regional bus lines are extensions of the rapid transit system, bringing passengers to locations where they can use rapid transit for the remainder of the trip.

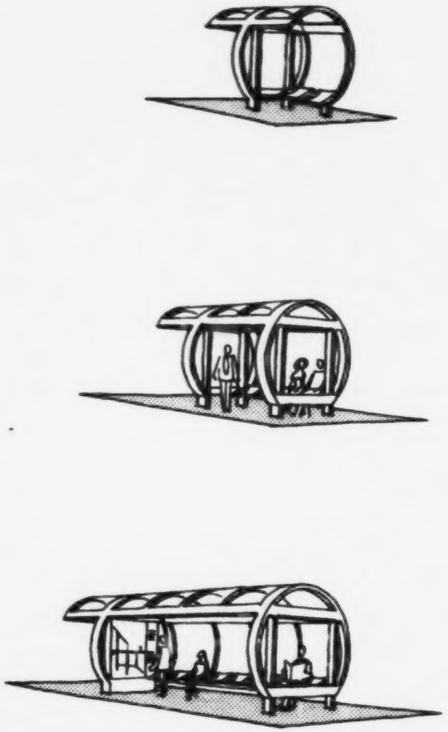

GREELEY
LONGMONT
BOULDER
GOLDEN
DENVER
CASTLE ROCK
Regional Bus Routes
Local and Express Bus Routes

Bus Shelters

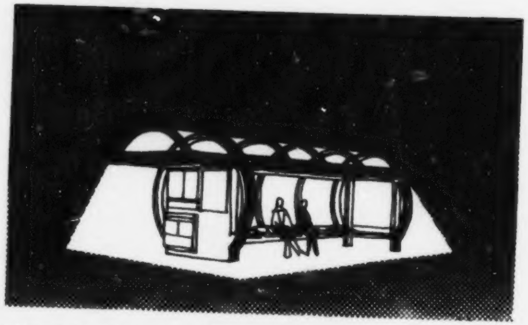
Major emphasis has been placed by RTD on providing bus stop shelters throughout the system. A flexible design has been suggested that can be adapted to the smallest neighborhood stop for a local bus and to an express or regional bus stop serving large numbers of passengers. The design is coordinated with the rapid transit station design.

A modular structure has been developed which can be expanded by adding modules to make up shelters of a number of different sizes. Two, four and eight seat modules have been designed which can be used individually or in combination with each other. Even the smallest shelter will provide seating and protection from the weather.

The larger structures will have at the minimum such services as lighting, bike racks and a radiant heating system for winter. The largest units of eight seats up to 30-40 seats or more will have telephones, newspaper vending machines, police/fire call boxes, drinking fountains and in the largest shelters, drink and food vending machines. While use of the shelter will determine to some extent the services offered besides weather protection and seating, the RTD objective is to make the bus shelters as comfortable and as convenient as possible. As a part of the bus network, the larger shelters also will be designed to serve as coordination points for all levels of bus service—local, express and regional.



Modular Bus Shelters 2, 4 and 8 seats



Night Lighting of Bus Shelter

Auto Intercept

The automobile still will play an important part in delivering passengers to the public transportation system, and particularly to the express bus, regional bus and PRT systems. Regional and most express bus service will originate at what is known as an auto intercept—a point where the drivers and passengers of autos can collect at one spot to board the bus or PRT system.

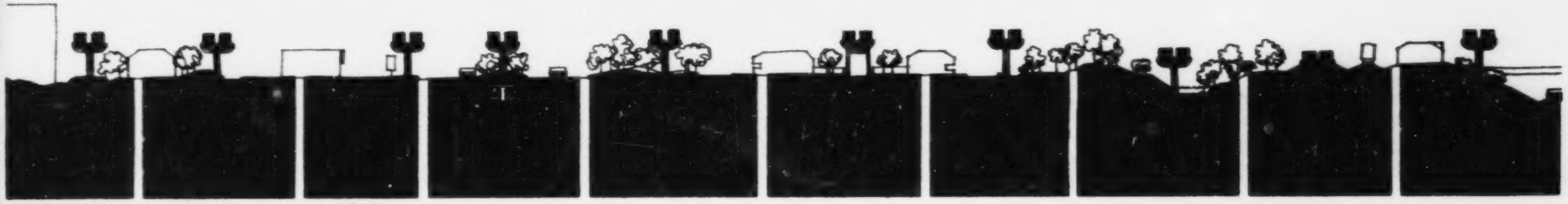
An auto intercept can vary from a parking lot, such as at a regional shopping center, to a special facility built as part of the transportation system. The largest auto intercepts also will be collection points for local, express and regional buses bringing passengers to the PRT system. The larger intercepts will have provision for "kiss 'n ride" lanes—a descriptive term indicating a lane where cars can drive up, the passengers be let out or picked up, and the auto driven away. The term originates from the practice of wives bringing their husbands to a station, kissing them goodbye and then keeping the family auto during the day until the husbands are picked up at night.

PRT Routing

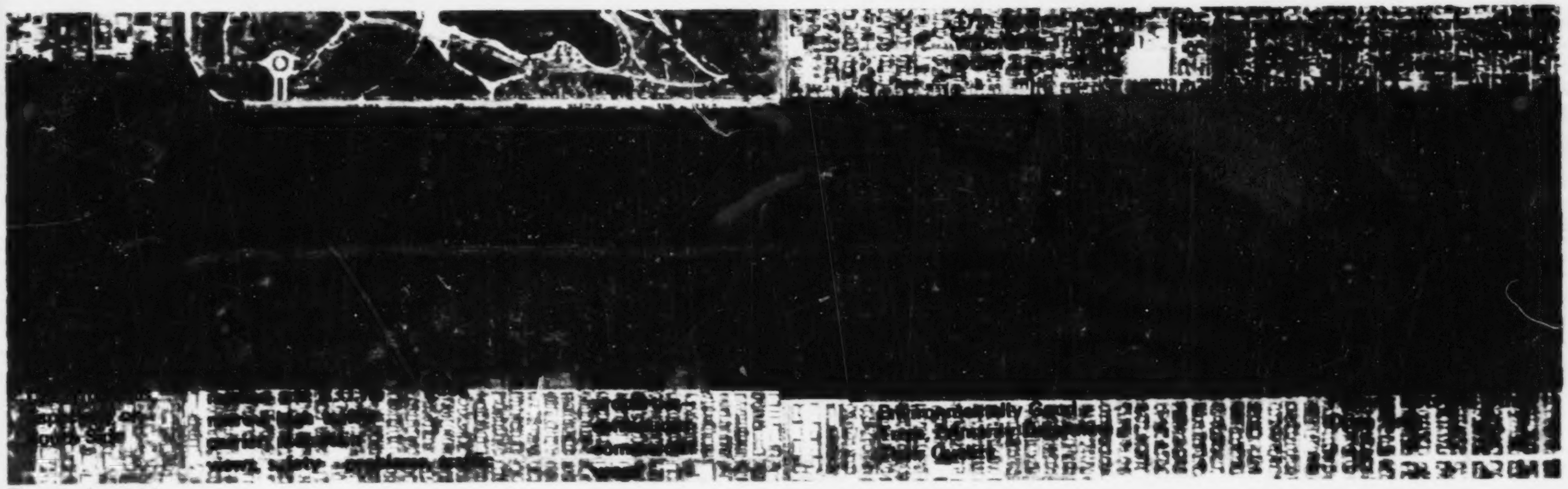
Routing of the fixed guideway system is the least flexible of all services. Thus, the greatest amount of consideration of routing by RTD has centered on the PRT system.

Travel within an urban area tends to concentrate along certain streets or highways. These are either the most direct routes and/or are capable of handling the heaviest traffic. Sometimes geography determines their location. In transportation planning these are known as travel corridors.

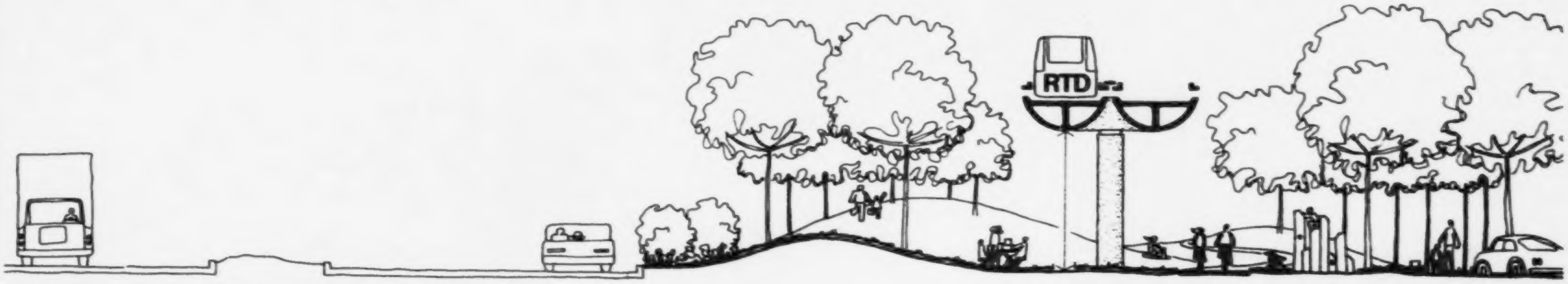
The land use and transportation concepts in combination with the highway concept and travel pattern information identified corridors of heavy existing demand for transportation service. Projections helped locate other areas and corridors that will experience increasing travel demands in the future.



PRT Right of Way Treatment Types



Route Analysis



PRT Right of Way Treatment Type 5, Linear Park

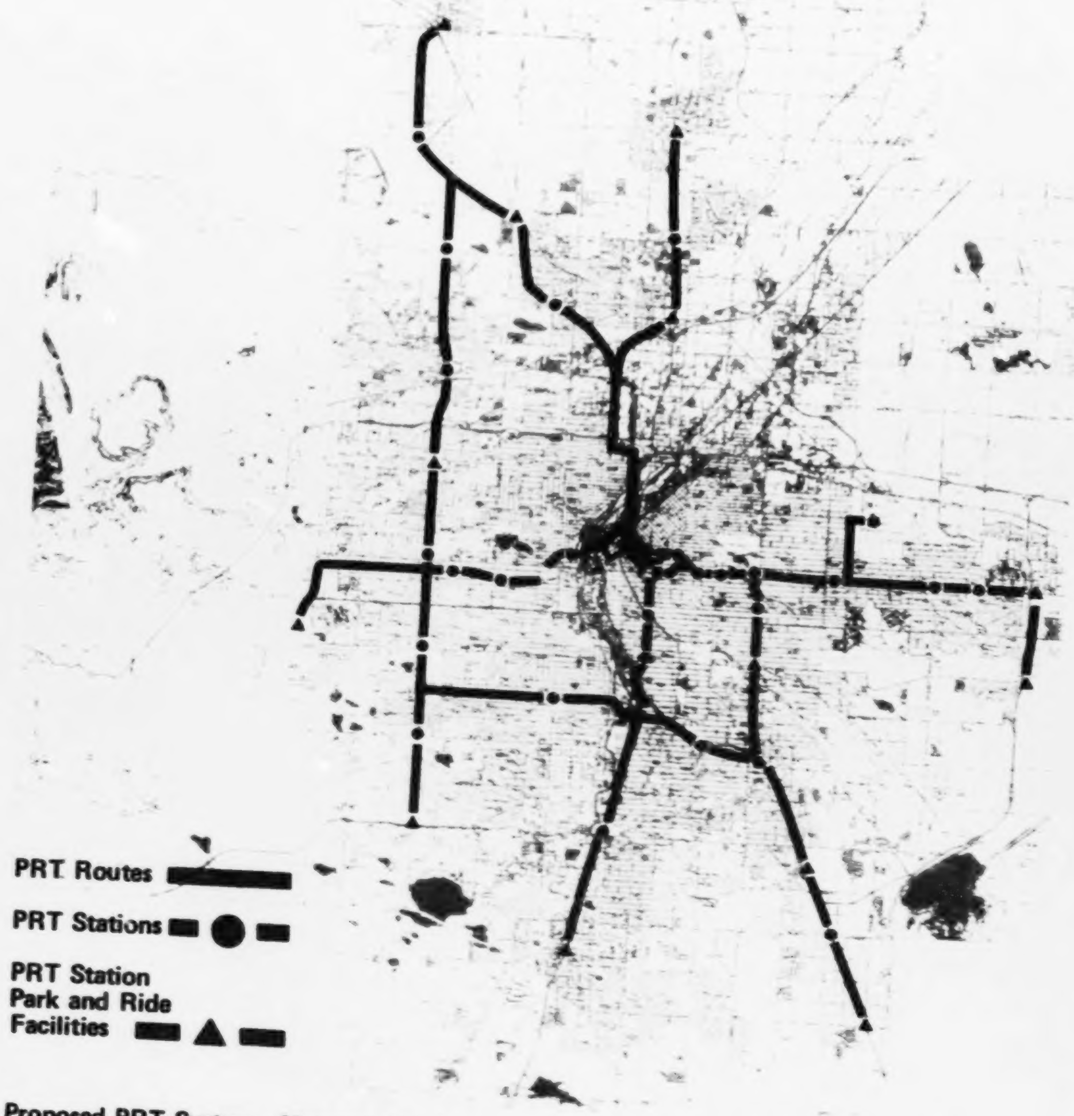
The corridors found to require PRT service are several blocks wide in some instances. Within each corridor lie several alternative alignments which meet the growth, service and engineering criteria governing design of the PRT guideway and system. To estimate capital costs, a "preferred" alignment was selected for preliminary engineering design in each of the corridors. Changes in the choice of an alignment can be made later in the process of final system design based on further studies and consultation with local officials and residents.

The selection of the preferred alignments and station locations was based on testing each possibility against guidelines established in relation to four kinds of impact—economic, social, environmental and ecological. These guidelines can serve in the future as a basis for re-evaluation of the routes or selection of new alignments.

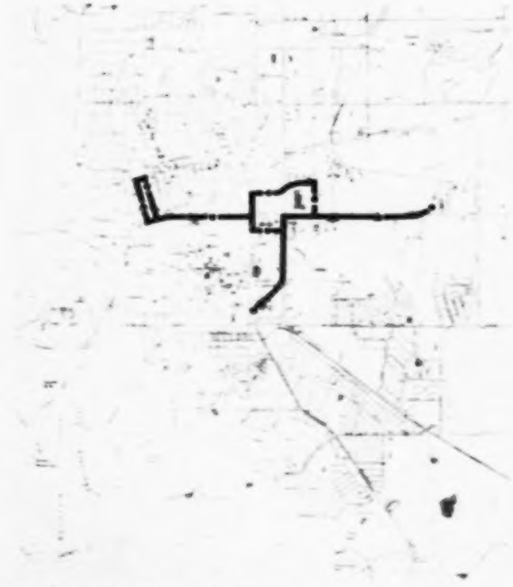
These guidelines include detailed examination of the following factors, among others: displacement or disruption of homes, neighborhoods, or businesses, development impact, traffic flow and convenience, scenic resources, historic sites or buildings, views and vistas, soils, geology, hydrology, noise, and air quality.

These factors were weighed and a recommendation made as to the alignment which best meets the combination of all the criteria. The specific alignments have not been approved as such by RTD. Changes in the choice of an alignment can be made by discussion of the possibilities with local residents and business people. In the end, it will be such discussion, and detailed design and engineering, which determine the final form and location of the PRT alignment.

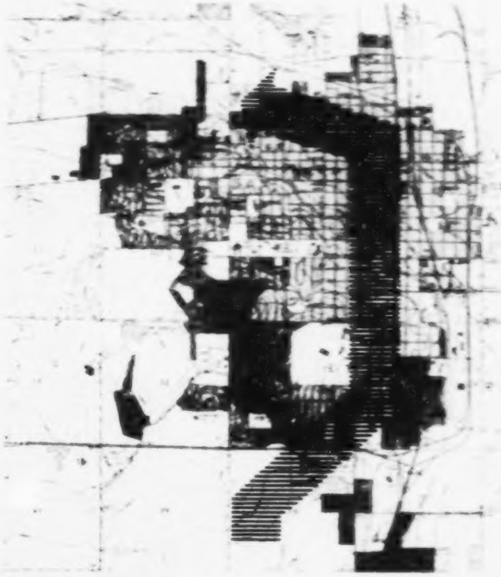
PRT routes are shown in downtown Boulder, downtown Greeley, and the metropolitan Denver area.



Proposed PRT System - Metropolitan Denver



Boulder PRT Route Map



Greeley PRT Corridor Map

The proposed Boulder PRT system includes three suggested routes tied together by a PRT loop in the area of the Crossroads shopping center. One route would begin at 28th and Arapahoe Road, goes south along 28th and then turns southwest across the University of Colorado campus to Folsom Street. A possible downtown route begins at 23rd and West Arapahoe Avenues, heads west to 13th Avenue, and then divides in a loop north on 13th to Spruce, west to Broadway, and finally south to Arapahoe. An east route would begin at 30th Avenue and Arapahoe and continue east past the proposed 47th Street parkway. The Crossroads loop would tie the three together.

A very broad PRT corridor was identified for Greeley rather than the more specific alignments suggested for Boulder and metropolitan Denver. The northern end of an initial PRT system will originate near the heart of downtown Greeley at "8th and 8th." The corridor then extends south to the University of Northern Colorado campus and the proposed regional shopping center. The proposed University stadium would be included as a point served by PRT.

In the Denver metropolitan area, the corridors are basically on east-west, north-south axes. A route in the area of Colfax Avenue serves the east-west corridor. Interstate 25 provides the right-of-way for the majority of the north-south and south-east corridors, with variations to the north-west along the Colorado and Southern Railroad right-of-way to Broomfield and to the southwest along Santa Fe Drive in the railroad right-of-way to Littleton. In Jefferson County, an additional north-south route is provided along Wadsworth Boulevard from West Hampden Avenue to West 88th Avenue, as is also the case in east Denver along Colorado Boulevard from Colfax to I-25. Additional east-west routes are provided along Buchtel Boulevard from Colorado Boulevard to Louisiana and Santa Fe, then along West Mississippi Avenue to Wadsworth. In addition to circulation systems within the downtown Denver area, routes from main corridors are provided to serve activity areas such as the Federal Center, Stapleton Airport and the projected future downtown center of Aurora.

With the exception of a tunnel on the North Wadsworth PRT line, all of the system planned is essentially on aerial guideways outside the downtown Denver area, including the PRT planned for Boulder and Greeley. In the Denver central business district, a subway is planned from the vicinity of Union Station along 16th Street to Broadway and Colfax. From this point, one subway continues south on Broadway emerging to an aerial guideway at 10th Avenue. Another subway line goes east on Colfax to Washington Street where it also emerges as an aerial guideway. The remaining PRT routes in downtown Denver are aerial.

While the physical features of the system as presented here are those that describe the system as it can be, the RTD recognizes that local communities might desire changes or additional features for their own reasons. RTD will work with those communities and make changes within the financial limits of the plan. Additions or changes which add to the cost of the plan can also be made, but in those cases the local community involved would be expected to provide additional financing.

Construction of the subway portion will be staged to provide minimum disruption to traffic or business on the affected streets. Excavation can be carried out over short segments and then be covered by a structure that will support pedestrian and vehicle traffic while the tubes and stations are being constructed underneath. With careful scheduling and coordination, business will be able to continue as usual for the most part except for the added activity associated with any major construction project. RTD will study construction of other subway systems, particularly the one underway in Washington, D. C., where major construction has been successfully carried out without substantially interfering with traffic and business.

PRT Guideway Design

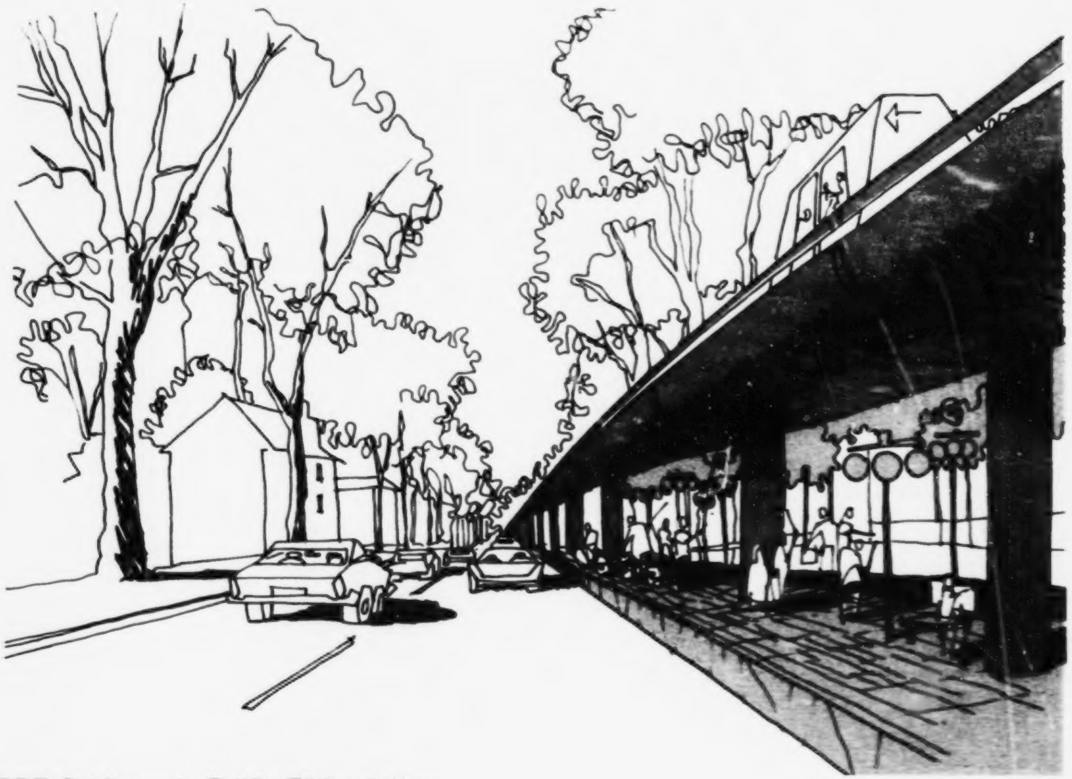
As mentioned above, most of the PRT system is on aerial guideways. This choice— as opposed to subway or at-ground-level tracks— was based on several considerations: first, an above ground guideway is considerably less expensive than a subway. An aerial guideway creates less interference with cross streets, for example, than a ground-level alignment. An aerial guideway also is inaccessible to curious children and other persons, eliminating the need for wide bands of fenced right-of-way. Particularly in open land such as along I-25, the height of the guideway can vary with the terrain and still remain level, whereas a ground-level guideway would require cut and fill to eliminate slopes.

An aerial guideway also offers the opportunity to contribute new facilities to a neighborhood which aren't possible with a ground-level system. The RTD plan provides for design to construct parks, play areas, bikeways, walkways, landscaping and similar features beneath the guideway. Since it doesn't have to be fenced, the area underneath the guideway can be open to the public to enjoy these facilities. The Lakewood Gulch area south of West Colfax Avenue, where a portion of the PRT line is proposed, is an example of an area where a positive improvement can be made by addition of a park in conjunction with the PRT.

The guideway has been designed to make it as attractive as possible. Since the PRT vehicle is smaller than conventional railroad or rapid transit trains, the aerial structure will not be as imposing or bulky as an elevated train structure. The color and surface finish can be designed to be attractive also. The actual physical requirements of the system, such as the radius of its curves and clearance requirements at cross streets, influenced design as did passenger comfort and visual attractiveness.

The following urban design requirements have been established:

- size and shape compatible with adjacent neighborhoods.
- coordination with urban services such as lighting and utilities.
- design adaptability to a variety of locations.
- economical to construct and maintain.
- column spacing allowing views between columns, consistent with engineering requirements.



PRT Guideway in Public Right-of-Way

- surface finish capable of variation to meet needs and desires of surrounding neighborhoods.

The preliminary guideway design finally selected from among five alternatives has the following features:

- concrete, precast, post-tensioned segments.
- single guideway sections which can be put into a double guideway supported by a single column, or can be built as separate units.
- rounded section profile with a variety of formed surface treatments.
- provision for incorporation of lighting and other urban services on the underside.

A number of different guideway treatments were developed to fit varying situations along the recommended routes for PRT. The illustrations suggest areas in which they might be most appropriate.

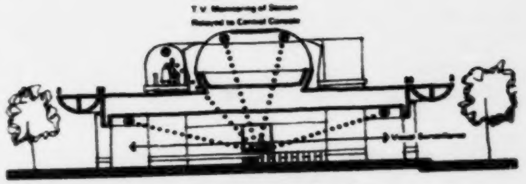
PRT Station Design

The total PRT system includes 68 stations for approximately 100 miles of guideway. The selection of station locations was based on analysis of patronage, socio-economic and environmental data, visual and physical impact on the neighborhood, cost of the location, and operational requirements and functions. Actual architectural design has been carried out to verify the concepts and provide for capital cost information, but many variations are possible.

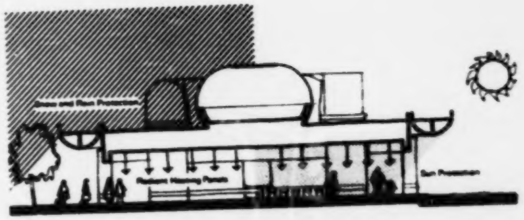
Features of the stations include wide passenger platforms, escalators and elevators in all stations to maximize movement of the elderly and handicapped, open areas underneath to accommodate large numbers of people disembarking from buses and autos, and pedestrian bridges across streets where needed. The station platform area will be enclosed and air conditioned for year-around comfort to enhance the attractiveness of the service and also to help maintain air conditioned comfort in the PRT vehicles. Harmonious colors and pleasing views also are part of the station design considerations. Subway stations will be opened to the sky as much as possible through skylights or open entirely at a mezzanine level.

Materials, finishes and general shapes of all PRT stations and the bus shelters will be coordinated so that RTD facilities can be readily identified throughout the District. Additional graphics will identify the type of facility through colors, symbols and explanation. Once the rider enters the station, information panels will tell him how to use the system, and displays on the platform will tell him the destination of the next vehicle. A station supervisor at each station will be available to answer questions and oversee its operation and to provide an extra measure of security for passengers.

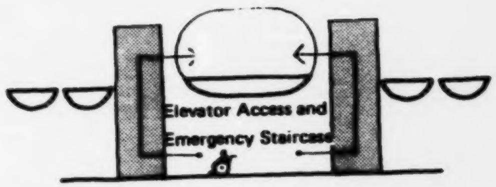
For the convenience of passengers on the PRT system, telephones, police and fire call boxes, drinking fountains, community bulletin boards, bike racks, newspaper vending machines, controlled access rest rooms and other services are designed into the station concept. Lighting in all areas, including pedestrian bridges, walkways and parking lots adjacent to the station, will be sufficient for adequate security. The station platform and the open area beneath the station have been designed to provide for closed circuit TV surveillance by the station supervisor.



Security Elements at PRT Station



Weather Protection at PRT Station

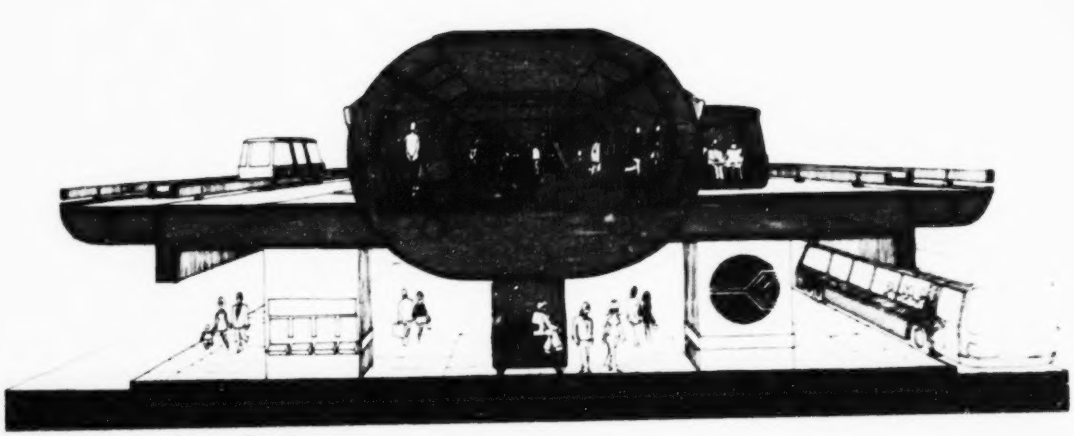


Elevator Access at PRT Station

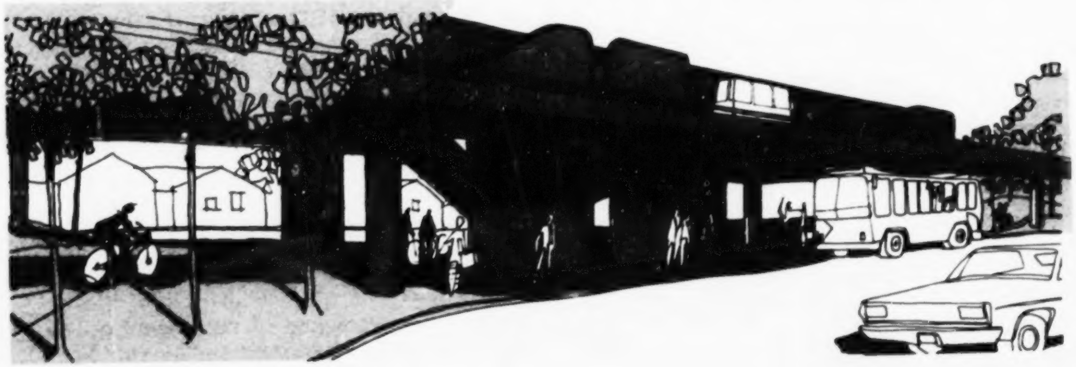
All PRT stations are located off-line—in other words, a PRT track angles off the main line to serve the station for loading and unloading vehicles and then merges with the main line at the other end of the station. Traffic can continue on the main line, with vehicles switching into the station and merging back onto the main line as necessary. The stations vary in size and they also vary in operation as either "batching" or "docking" stations.

This is a typical PRT station; illustrative of a facility that meets the design guidelines which were established for the PRT system. The design shown here is not intended to be the only design solution. There are many possible designs which will perform the desired functions. The station design shown here was used, however, to help obtain capital cost estimates for the PRT system.

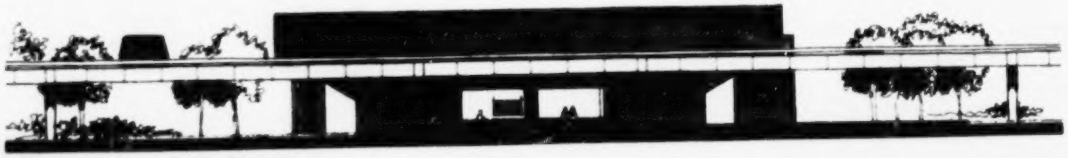
This station is a "docking" station, with open ground level concourse and enclosed passenger platform above it.



PRT Station - Cross Section



PRT Station



PRT Station - Side Elevation

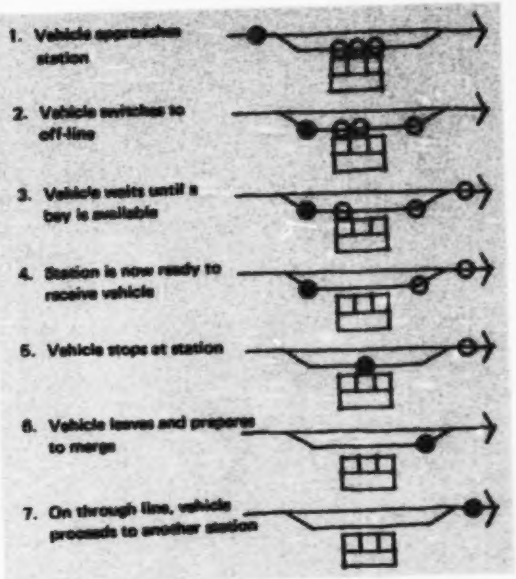
At a batching station, the vehicles line up on the track parallel to the station platform while they load or unload. The first PRT vehicle in line must leave the station to return to the main line before the vehicles behind it can move. In the docking station, the vehicles stop parallel to the station and then are mechanically moved into a dock or bay off the station track to one side for loading or unloading. When ready to leave, they are shifted back onto the track in a procedure that takes a few seconds. The docking procedure permits vehicles to move past vehicles docked off the track and provides greater station capacity than the batching station. All batching stations have been designed so that they can be converted to docking if necessary to meet increased use of the station.

Security and Safety

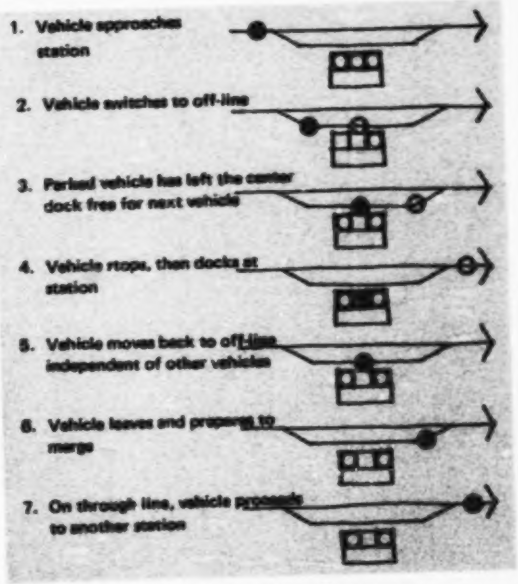
A primary consideration for a public transportation system is the safety and security of the passenger. When the final PRT technology—vehicle and control system—is selected, RTD will be able to define a very specific program to ensure passenger safety and security on the PRT system.

In general, plans call for an automatically controlled system with constant monitoring by RTD personnel, and provision for a manual override of the automatic system in the event of an emergency. The automatic, computer-controlled system will regulate such things as location of vehicles, distance between them, speeds, direction and destination. This information will be displayed on an electronic board so that personnel monitoring the system can see what is taking place on the system.

Passengers in the vehicle will have two-way communications with the control center when necessary. They can either report a problem to the control center or receive instructions from control center personnel in the event of an unusual situation. The attendants assigned to each station also will be able to monitor operations of the PRT vehicles within the stations.


1. Vehicle approaches station
2. Vehicle switches to off-line
3. Vehicle waits until a bay is available
4. Station is now ready to receive vehicle
5. Vehicle stops at station
6. Vehicle leaves and prepares to merge
7. On through line, vehicle proceeds to another station

Batching Station Operation Sequence


1. Vehicle approaches station
2. Vehicle switches to off-line
3. Parked vehicle has left the center dock free for next vehicle
4. Vehicle stops, then docks at station
5. Vehicle moves back to off-line independent of other vehicles
6. Vehicle leaves and prepares to merge
7. On through line, vehicle proceeds to another station

Docking Station Operation Sequence

The vehicles are capable of operation either forward or backward. Personnel at the control center can take over their operation and route them to the nearest station or any other destination. The vehicle doors can be opened from the outside if necessary.

Security for passengers in the stations and on vehicles will be provided by a combination of closed circuit television and voice communication, the latter available in the vehicles. The station attendant will be able to view all levels of the station on closed circuit television to be able to prevent vandalism or other activity.

The station television monitor also will be viewed at the control center for a double check. In addition, at the control center, closed circuit television surveillance of parking lots, maintenance areas, and other areas will be provided. Thus, control center personnel will be able to monitor the information displayed on the electronic control board by actually being able to see the problem. In addition, they also will monitor each of the stations.

Emergency procedures for special problems on the system plus such equipment as fire extinguishers and alarm systems will be developed once the PRT technology is determined. The objective will be to exceed the security and safety on even the latest rapid transit systems.

System Capacity

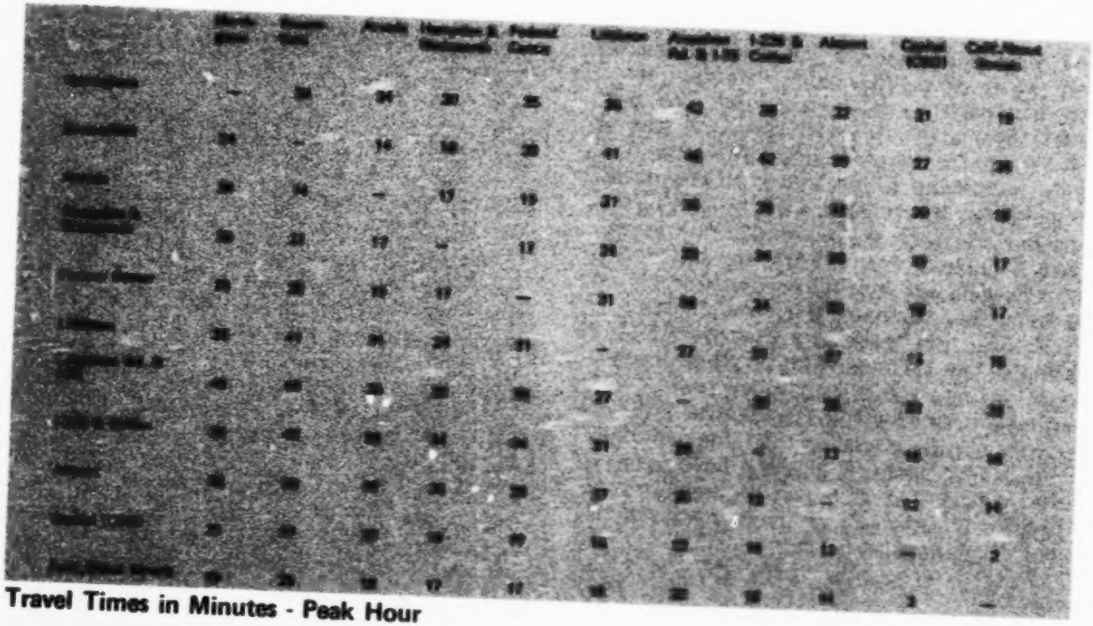
Will PRT be able to do the job? Factors affecting the capacity of the PRT network include the number of vehicles planned, 800 initially; the number of seats per vehicle, 12; the length of the guideway, 100 miles; the speed of 30-40 mph; and the eventual planned headways or distances between vehicles of 7.5 seconds (330 feet at 30 mph and 440 feet at 40 mph). If, for instance, each of the PRT vehicles makes 4.4 trips per hour with all 12 seats filled, the theoretical capacity of the system is 42,240 passengers per hour.

The design of the system provides for excess capacity even during peak rush hours, which enables the system to respond to changing service requirements to meet any situation quickly and efficiently.

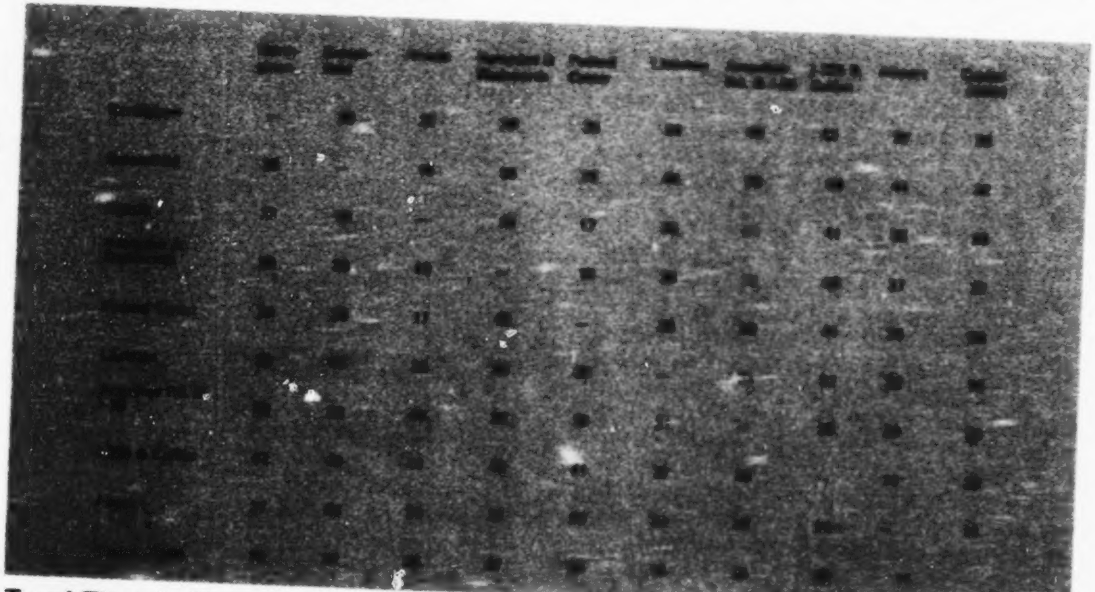
PRT Travel Time

The two accompanying tables present sample station-to-station travel times on the PRT system. The first table gives non-stop travel time which will be possible on the system during the less busy times of day. The second table allows for stops during peak hours when, for example, passengers will be picked up at more than one station in order to fill the PRT vehicle. While some times might appear excessive, such as between Broomfield and Northglenn, this is a function of the layout of the network and a bus connection between the two cities will provide a much shorter transit trip than PRT. Some of the times between stations, shown on the tables, do not appear to be significant when compared to today's auto travel times, but it should be remembered that trips by auto will take much more time in 1983.

Sample travel times on the Boulder PRT system are 8 minutes from the Civic Center



Travel Times in Minutes - Peak Hour



Travel Times in Minutes - Non-Stop

station downtown to the 47th Street station and 3 minutes from the 30th Avenue station east of the Crossroads Shopping Center to the University station.

How Many People Will Use Transit?

In designing the system, it was important to develop projections as to how many people reasonably could be expected to use the total transportation network. The current projections are based on present and projected travel information which tells RTD where people are going and why. This information is entered into a computer program which basically tells when a person might be expected to ride a bus, drive his car or take the PRT. Combined with population projections, the final report RTD receives from the computer gives it ridership figures, or the estimated patronage of the transportation network.

The accompanying table indicates the total estimated highway and transit trips in 1970 and the projected trips for both in the year 2000 with the RTD transportation system in operation.

Public transportation will not replace the auto as a principal means of transportation, particularly for shorter trips. While in 1970 about 101,000 passengers were carried daily by transit, the projections are that more than 1,163,000 passengers will use transit in the year 2000. Transit is most used for longer trips which concentrate in the heavily traveled corridors. As a result, transit reduces the amount of time autos are driven, along with the amount of pollution and congestion they create in major traffic corridors.

Out of the 1.1 million passengers expected on the RTD transportation system each day in 2000, approximately 461,000 will ride the PRT. At an average occupancy of 1.4 persons per auto, more than 325,000 autos would be necessary to carry the same number of passengers in the same corridors. Much of the transit service will be concentrated where it is needed most and the greatest contribution can be made. The bus passenger level will be quite high since it will be a primary means to reach the PRT stations. The express bus also will relieve congestion in heavily traveled corridors—170,000 autos would be needed to handle the same passenger volume.

Another way to look at the patronage data is to note that by the year 2000 more than 1 million passengers could be traveling more than 4 million miles per day in air conditioned comfort and safety—and someone else will do the driving.

The more concentrated the activity in an area of the region, the greater the requirement for public transit and the more significant its contribution will be. For example, in the Denver central business district nearly 27 percent of all person trips and about 53 percent of all work trips will be made on public transit once the system is in operation, compared to about 17 percent and 23 percent, respectively, by transit today.

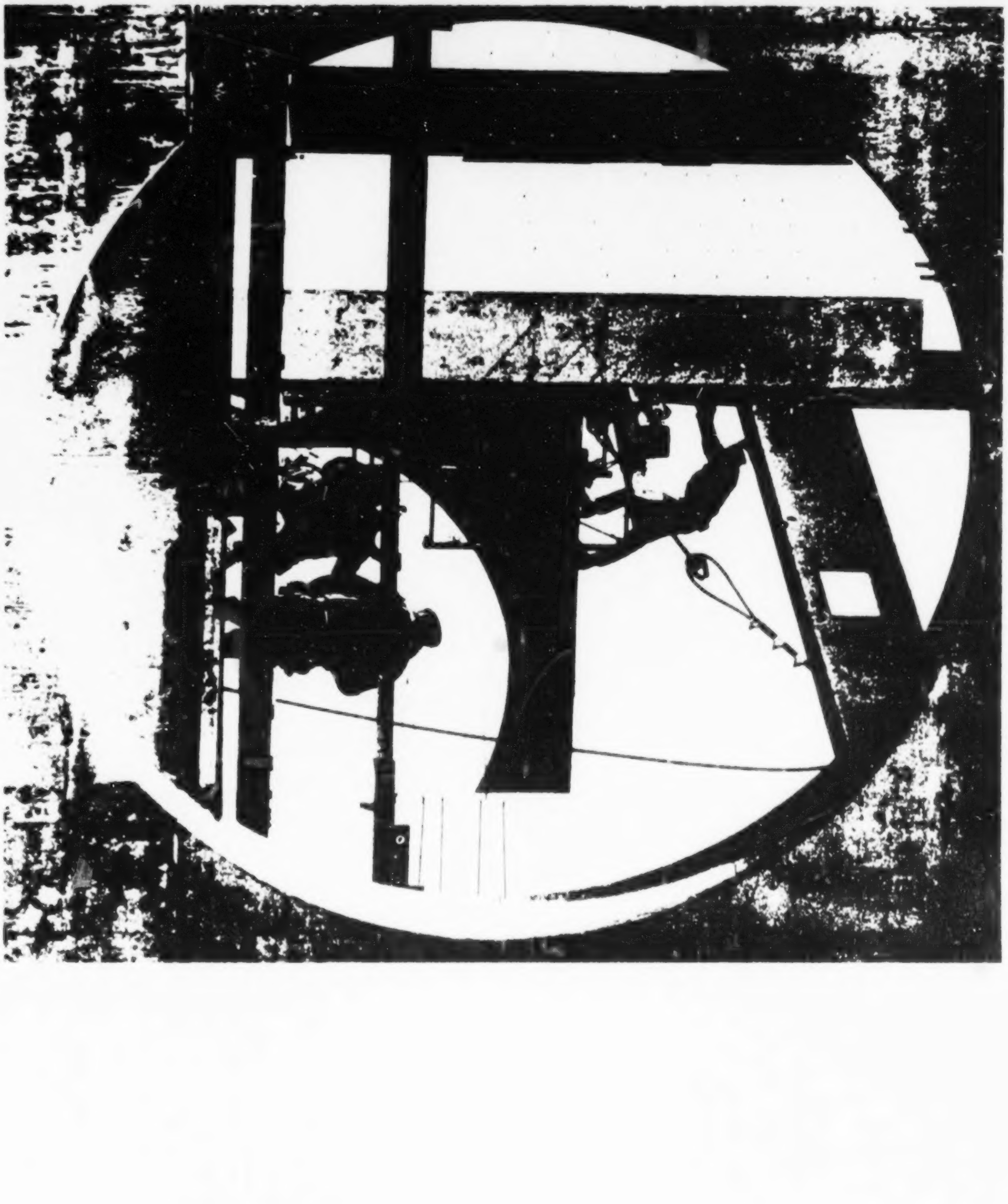
During the morning and evening rush hour periods with the transit system operating, 12,000 persons will arrive and depart from the Denver central business district according to estimates (although the capacity of the system for downtown Denver will be more than 23,000 per hour). The 12,000 peak hour transit passengers, if they had to travel downtown by car, would require nearly 10,000 parking spaces or almost seven square blocks of parking space.

	1970	2000
PRT	—	461,000
Local Bus	97,000	459,000
Express Bus	4,000	243,000
Total	101,000	1,163,000

[1] A person is counted as a transit passenger each time he rides a separate mode. A trip by one person who makes a transfer from bus to PRT is counted as two passengers.

Source: JRPP

Summary of Current and Projected Daily Transit Passengers [1]



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Getting the Job Done

The real work will begin for RTD when the voters approve a public transportation plan for the District. The RTD then will have the responsibility for selection and acquisition of equipment, installing service, determining the exact route alignments, purchase of right-of-way, organizing a management team, supervision of construction, coordination with local governments and private agencies, and a host of other activities necessary to getting the job done properly. RTD already has initiated action that will accelerate implementation of the transportation plan when it is approved by the citizens of the region.

Environmental Review

During 1971, the first full year of planning for RTD, an important task undertaken was the inventory of regional ecological, environmental, social, economic and cultural characteristics. The information formed a base on which the transit system was planned in keeping with RTD objectives to protect the natural environment of the region while responding to the existing community needs.

To carry its concern for compatibility and for positive contribution a step further, RTD has employed an environmental consultant team to review the environmental and socioeconomic impact of its recommended plan. The team is composed of Theodore J. Wirth and Associates of Billings, Montana, a national land and resources development planning firm, in association with Louis Berger, Inc. of East Orange, New Jersey, an international company with extensive experience in the assessment of the social and environmental impact of transit systems.

Early Action Program

The RTD can institute almost immediate steps to improve public transportation in the District. This plan, which has been developed in advance, will go into effect to extend transportation to areas which today have none and to improve it in other areas. Termed the "early action program," the plan will rely on the bus system to immediately improve transit service in the District. The early action program will provide an immediate impact on air pollution as one step toward meeting the Environmental Protection Agency requirements.

Denver Metro Transit, as a result of the improvements instituted by it during the past two years, has attracted considerable new ridership to the bus system and provided a good base on which to build. RTD will act to expand the limited metropolitan service of Denver Metro Transit into a regional system.

An important objective of the early action program will be to begin to establish the "transit habit" among District residents. Extended and improved transit service is expected to attract increasing numbers of riders who later will support the completed transit system. The program is also designed to help establish the travel corridors and patterns that will later reinforce ridership on the PRT system.

In anticipation of a successful vote, applications will be prepared for immediate submission to the Urban Mass Transportation Administration of the Department of Transportation for funds to acquire the Denver Metro Transit system, buy new buses, construct shelters and purchase land for a new bus storage facility. The RTD will request bids on equipment. Generally speaking, companies that build buses do not maintain an inventory of equipment, but instead produce them over a short period once each year after specific orders have been received from transit authorities, so that some delay will be necessary once bids have been received and an order placed.

Assuming a fall 1973 vote on the transportation plan, a possible date for installation of the improved bus service would be early fall of 1974. Construction of bus shelters could begin before this date and some other minor service improvements would be possible. But effectively within a year, the early action program would be implemented and by the end of two years it would be in complete operation.

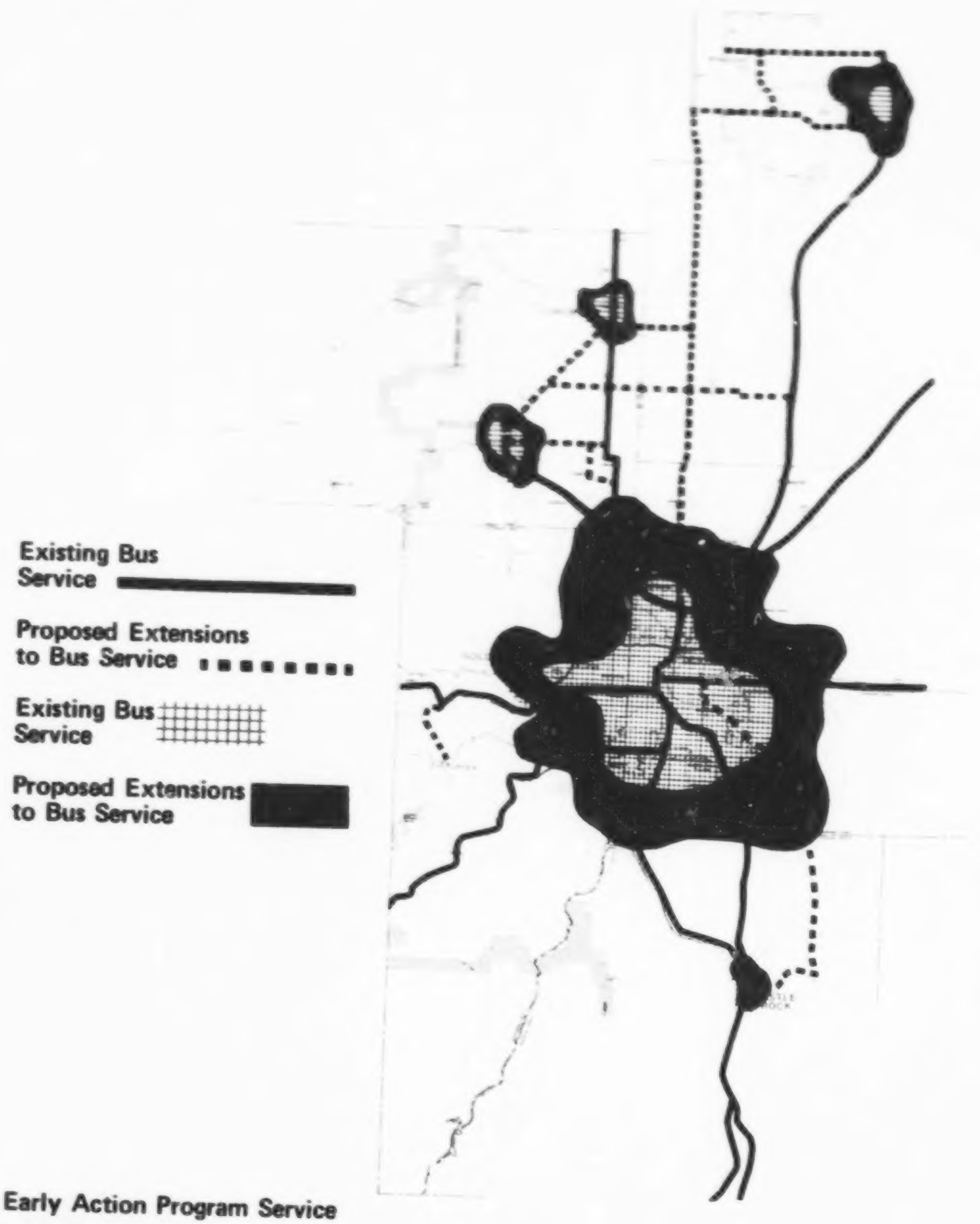
Early Action Program Service

The early action program envisions an increase of 270 route miles of bus service in the region, or an increase of 61 percent compared with present bus service in the District. Daily bus miles will increase by some 33 percent to about 32,000 miles.

To provide this increase in service will require 115 new buses. The RTD plans to acquire modern buses similar to those now being put into service by Denver Metro Transit, incorporating advanced features such as air conditioning and air pollution control equipment. Bus shelters will vary in features depending on location and level of use, but in the more active locations they will be lighted, heated, and will have telephones and similar services.

Specific service improvements will be in frequency on existing routes and establishment of new routes. Major areas of expanded route coverage are:

- north-south crosstown service in Jefferson County, plus express service to mountain communities and an added route to Golden.


Existing Bus Service
Proposed Extensions to Bus Service
Existing Bus Service
Proposed Extensions to Bus Service

Proposed Early Action Program Service

- extended service to the southwest including a Broadway extension, Santa Fe express and a line west from Englewood on Hampden.

- expanded express service to the southeast along I-25, Parker Road, Holly and Yosemite Streets, plus total service on Arapahoe Road and Hampden Avenue.

- increased service to Aurora, including crosstown service on Havana Street, local service on Leetsdale Drive, and a direct connection to Montbello.

- extension of local service to Commerce City and Adams City.

- extension of The Mini route in Longmont.

- expansion of bus service in Boulder.

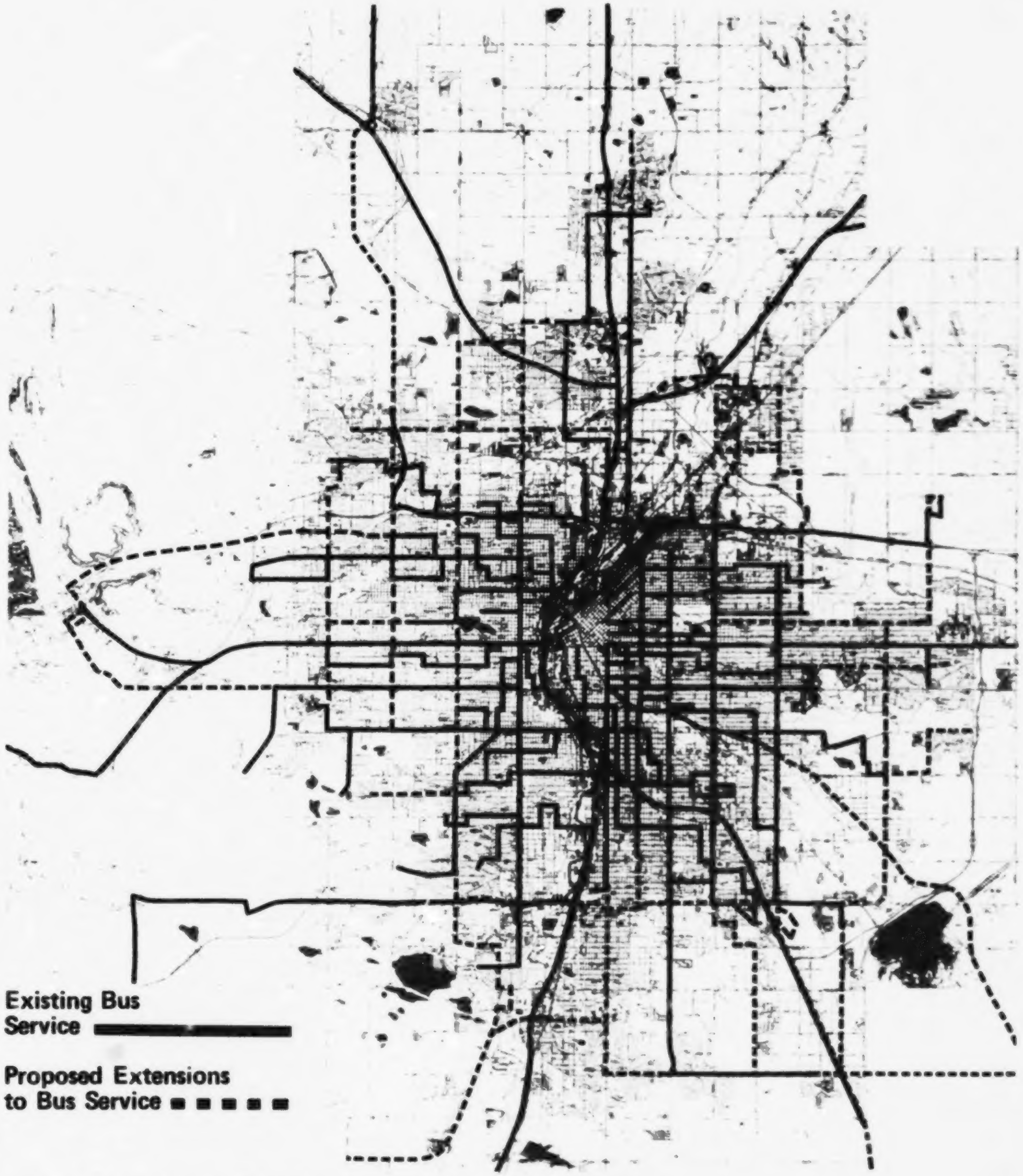
- rerouting and expansion of bus service in Greeley.

- additional regional links connecting communities such as Parker, Castle Rock, Lafayette, Louisville, and Brighton to the regional centers such as Denver, Boulder, Longmont, and Greeley.

Existing Bus Systems

An important consideration in the early action program will be the status of existing public transportation services in the District, all of which are bus systems. Following are the existing public and private companies:

Greeley Municipal Bus Line
Northglenn Suburban Company
Denver Metro Transit
Greyhound Bus Lines
Continental Trailways



Proposed Early Action Program Service - Metropolitan Denver

Public Service Company of Colorado, Boulder Division

Denver-Boulder Bus Line

Englewood-Littleton-Fort Logan Transit Line

Acquisition of Denver Metro Transit is essential to the efficient implementation of both the early action program and the complete plan. Coordination of service will be necessary with other existing private and publicly owned bus systems. They will be studied and evaluated individually as to how service in each local area can best be provided. RTD expects that this question will be a matter for discussion between RTD, local communities and each existing bus system.

Based upon passenger projections for the year 2000 as discussed in the preceding chapter, the bus system required to support and complement the PRT networks would consist of 740 regional and local buses. They would operate over 1,630 route miles and provide approximately 85,000 vehicle miles of service per day compared to 24,000 vehicle miles today.

PRT System Implementation

In addition to the early action program, the other important milestone in improved transit service for the District will be the possible operation of the early demonstration portion of the PRT System by late 1976 or early 1977. The first portions of the regional PRT system will become operational by late 1978 or early 1979. As the PRT system is phased into operation, bus routes will be modified so that they both serve and supplement the PRT system.

Following voter approval, design and detailed engineering of the PRT network would begin and actual construction started in 1975. A test segment, (probably the Denver Demonstration Project) will be completed first and check-out run before construction proceeds. Construction would be phased to provide completion of entire lines within the network in order to make as much transit service available as soon as possible. For example, the line from Northglenn to Littleton and the line from the Federal Center to Aurora could be under construction simultaneously and completed first to maximize, at the earliest possible date, the interception of automobile commuter traffic. Construction of the subway portion of the network in downtown Denver should begin early to coordinate with the proposed 16th Street pedestrian mall planning and to provide the connection between the north-south and east-west lines. Construction of other segments would be phased to coordinate with highway and other community improvements.

The proposed PRT networks in Boulder and Greeley could be constructed independently and phased to be integrated with other improvements in those communities.

A preliminary construction schedule provides for approximately 20% of the PRT network to be in service by 1978, 50% by 1980 and the remainder by 1983.

Right-of-way acquisition, including station locations, is an element in developing the PRT network that also can get underway almost immediately after voter approval. Most of the right-of-way is in existing railroad properties or other existing public rights-of-way. In cases where parking facilities, stations, and the remainder of the right-of-way are planned on private property, it will come under the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act as amended in 1970 (URA Act).

Assistance for Residents

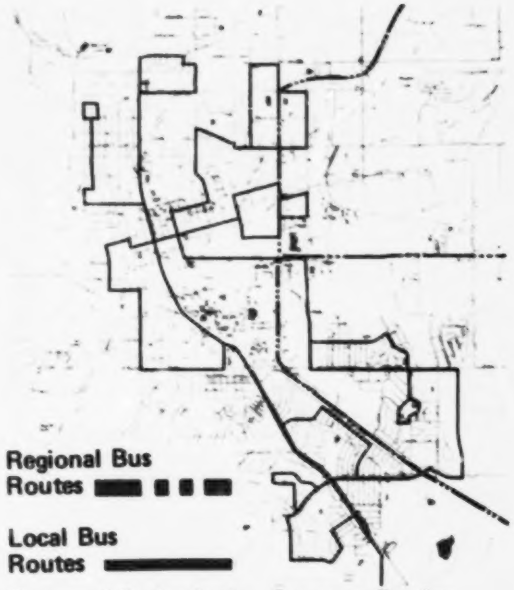
The URA Act applies to RTD since Federal funds will be involved. The URA Act specifies for all federally financed projects the following guidelines for assisting residents directly affected by the project:

- equivalent and suitable replacement housing through either one-to-one replacement or by presentation of evidence that the private housing market can accommodate the relocation.
- relocation advisory assistance.
- moving expenses not to exceed $300.
- dislocation allowance of $200 per household.
- payment of up to $15,000 (non-taxable income) to make up the difference between the acquisition price of the owner's house and the purchase price of a suitable, comparable housing unit.
- payment of up to $82 per month for four years for the difference in rent paid on a former residence and the rent payment on a replacement dwelling, provided the total monthly payment for the new housing does not exceed 25 percent of the person's income.

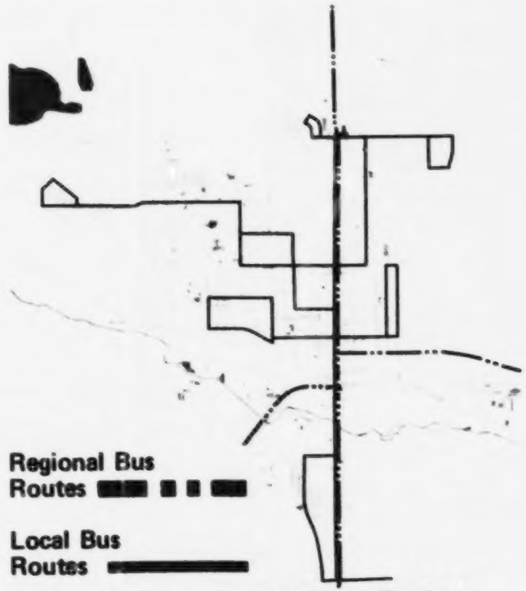
Assistance for Businesses

The same URA Act also applies to businesses and non-profit organizations displaced because of a federally funded program and these guidelines will be followed by RTD. In the case of businesses and non-profit organizations, the objective is to aid in their satisfactory relocation with minimum delay and loss of earnings. The URA Act states RTD must provide:

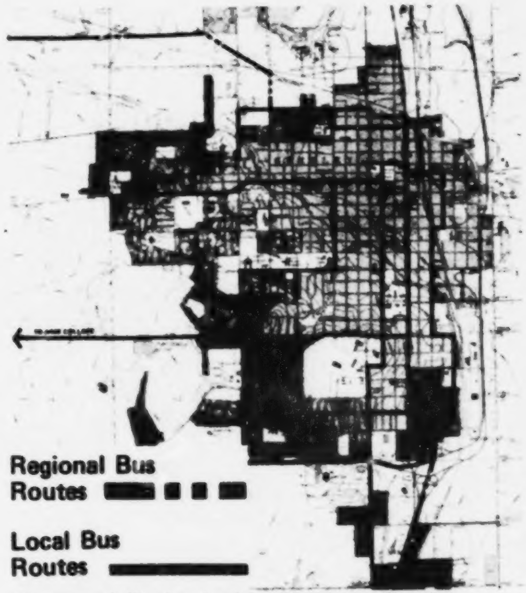
- payment of fair market value for property acquired by the District.


Regional Bus Routes ▬ ■ ■ ■
Local Bus Routes ▬▬▬

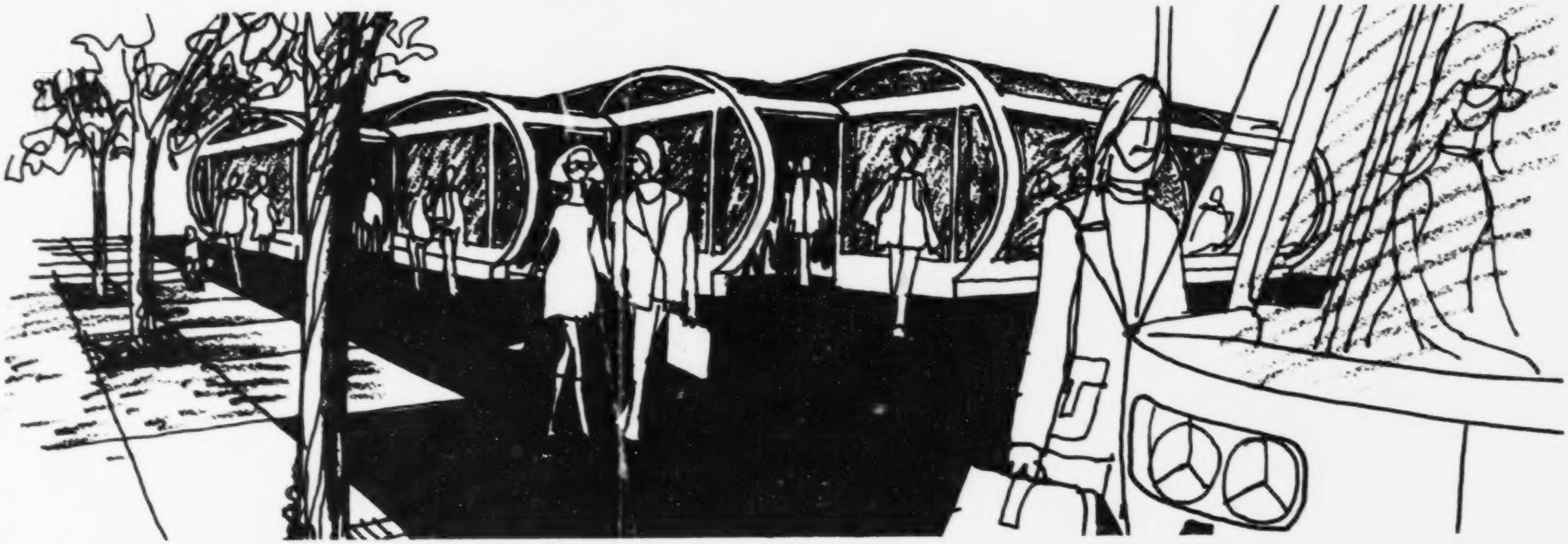
Proposed Early Action Program Service
Boulder


Regional Bus Routes ▬ ■ ■ ■
Local Bus Routes ▬▬▬

Proposed Early Action Program Service
Longmont


Regional Bus Routes ▬ ■ ■ ■
Local Bus Routes ▬▬▬

Proposed Early Action Program Service
Greeley



- payment of up to $500 for expenses involved in searching for a suitable relocation site.

- payment for actual moving expenses.

- payment for actual direct losses of tangible personal property.

- as an alternative to the above three payments and at the business's or organization's option, a lump sum equivalent to one year's average earnings, but not less than $2,500 or more than $10,000.

- relocation advisory assistance.

As of July 1, 1972, the URA Act applies uniformly to all relocation caused by displacement by a public agency. The provisions of the URA Act are equal to or greater than those of all previous laws covering relocation for either residential or business and non-profit organization property owners.

Energy Requirements for Transit

A detailed analysis of the electrical requirements and distribution system for operation of the PRT network will not be possible until a final technology is selected. Preliminary conclusions can be reached based on the characteristics of existing PRT vehicles and systems.

Preliminary contacts already have been made with the Public Service Company of Colorado and present estimates are that Public Service will be able to meet the requirements of the PRT system without substantially altering future projections of regional needs for electric power.

The RTD rapid transit system is estimated to require 290 million kilowatt-hours per year by the year 2000, with a maximum peak hour requirement of 87,000 kilowatts. The current peak hour capacity for Public Service is 1.9 million kilowatts and it is expected to be 2.6 million kilowatts by the end of 1973. The peak hour projection for electric power for RTD's system in the year 2000 thus is only 4.5 percent of the 1972 Public Service capacity and 3.3 percent of its capacity by the end of 1973.

Historically, Public Service has doubled its electrical generation capacity every seven years. Even if this rate of expansion should slow down in the next 30 years, the electrical requirements for the PRT system will be a very small percentage of the company's total generation capability.

From another viewpoint, the proposed RTD transit system could save by the year 2000 up to 240,000 gallons of gasoline daily or more than 72 million gallons each year. The estimate assumes that, with any transit system in 2000, an average auto would be operated at 15 miles per gallon over an average trip of five miles for every 1.2 persons who otherwise would have ridden public transit. The calculation sets savings by riding the PRT at 128,000 gallons of gas daily and by riding the bus system at 112,000 gallons daily, but does not take into account the fuel used by the buses.

While many circumstances can change by the year 2000, the rapid transit system proposed by RTD will not require a major commitment of electrical energy and in fact will be at the same time saving energy less efficiently expended by the auto. Since the PRT vehicles are non-polluting in operation, the net result will be positive.

Bus technology is expected to change considerably over the next 10 to 15 years. Since the current average fleet bus age is about 8 years and bus life is approximately 15 years, a completely new type of bus requiring less energy and producing little or no pollution probably will be in operation in the District by the year 2000. It is difficult at this time to estimate the energy requirements for the bus system.

System Management

Overseeing the implementation of a public transportation system involving the expenditures of $150 million or more per year and supervision of literally hundreds of suppliers will present a major management coordination problem for RTD to solve.

The District will need to employ a system technical integrator of proven capability in managing large, complex projects. The system integrator would not participate in any portion of the construction, hardware or operational effort in order to maintain independence and objectivity.

Among the management tasks which will require careful attention by RTD are:

- overall supervision of schedule and coordination of system engineering and implementation.

- making certain that the system is being designed according to specifications.

- integration of design of various elements of the system so that all fit together.

- assuring that a flow of information is maintained among all suppliers and agencies involved.

- monitoring contractor performance on schedule, budget and specifications.

- coordination of any system changes with those suppliers affected.
- cost control.
- setting procurement and contracting policies.
- maintaining quality control.
- initial test and checkout of equipment.
- developing training programs for personnel.
- establishing acquisition procedures for property required.

Modern management techniques will be applied to planning and monitoring the complete project so that the best transportation system possible is developed at the most economical cost.

Public/Private Coordination

Participation in the Joint Regional Planning Program and the continuing cooperative efforts with local governments have been up until now the first steps in what must become an intensive effort. In particular, location of the rapid transit system, design of facilities and other aspects of the network will have major impact. Residents of the affected areas must have the opportunity to consider the extent of this impact and to participate in decision-making related to it.

Coordination with the Colorado Division of Highways with respect to the use of highway funds for parking facilities and other surface transit requirements will be fully explored. Busways or exclusive highway lanes for buses have not been specifically identified as yet, but when instituted in response to demand and coordinated with highway programs, their development may be eligible for Federal Highway Administration assistance.

Coordination already has begun with railroad companies that own rights-of-way where installation of the fixed rapid transit system is proposed. In addition to access to the right-of-way for the rapid transit, railroad companies and RTD must work out agreements for liability during construction and operation, security and other questions brought about by having two different transportation services in the same right-of-way.

Other private companies also will be affected by the transportation network, which can influence their access to employees and

CITY OF LONGMONT/REGIONAL TRANSPO
DEMONSTRATION PROJECT

thus the desirability of locating in certain areas of the region. In addition, if RTD should add cargo service in any form to its system, this will bring additional private companies into the picture. Contact, coordination and cooperation will be developed by RTD with private interests as these possibilities become realities.

Community Activity Centers

Much of the success of future land use patterns will hinge on development of the community activity center concept. A community activity center is an area of one or several activities—shopping, housing, employment, entertainment—of sufficient size that innovative transportation systems can stimulate better organized growth and development in an area, growth which is neither auto-dominated nor-auto-dependent.

While proposed centers have been tentatively identified in the RTD plan, and have been discussed with appropriate governmental authorities, they require further investigation and discussion. RTD must depend on local and regional authorities to identify community activity centers if they are to reinforce land use plans for which these authorities have responsibility.

Once a center is determined to have that potential, RTD can assist in the technical planning and design of the transportation system which can guide development of centers.

From RTD's standpoint, any potential center should reinforce the land use concept for the region and it must favorably influence regional transportation in terms of quality, travel time and location. Overall the plan for the center must show a net gain in economic and social benefits.

Certain components of transportation and center development are necessary to achieve the best relationship between the two:

- connection with the other elements of the regional transportation system—either transit or highway.

- a transportation system internal to the center which could include small rapid transit, bus service, and parking facilities at the edge of the center.

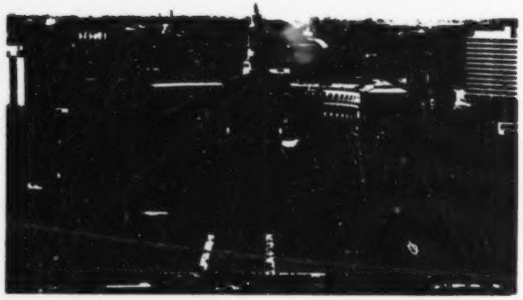
- pedestrian paths, overhead walkways, bikeways, and related landscaping, security and other aids to non-auto movement.

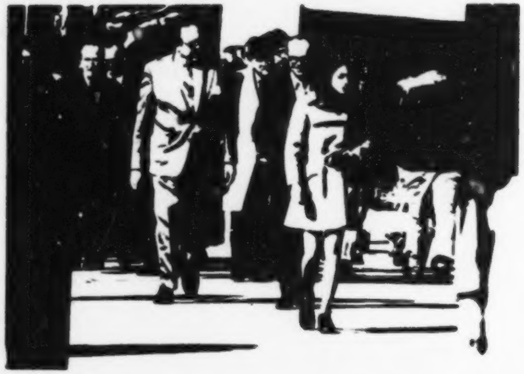
- a broad range of commercial, industrial and/or residential activities.

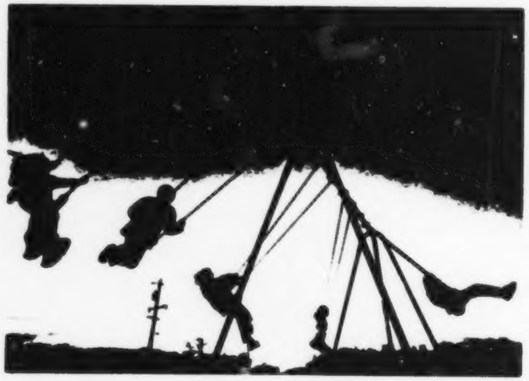
A variety of steps will be necessary to trigger reinforcements of community activity centers including public policy declaration followed by necessary legislation, private involvement and finally commitment of public transportation.

Existing Community Activity Centers and potential new centers have been identified, including both public and private. RTD has determined that it can participate directly in the development of center transportation systems only in the public centers, but that the overall system should recognize and support, through service, the private centers as well.

Guidelines must be established for identification of community activity centers and for participation on the part of RTD. This important element of the land use concept will require commitment and attention on the part of the public and of governmental agencies if it is to be achieved.







6

Benefits

Measuring all of the benefits of a public transportation system is difficult at best. But in the last 20 years, nearly every existing rapid transit system in North America and Western Europe has been studied to determine what the residents of the region served are saving by having transit available— how much they save by using transit instead of an auto, in time, in insurance, in gasoline, in freedom from accidents and in the many other costs associated with dependence on the automobile for transportation. The studies were carried out so that a measure could be established for the return on the investment made in developing a public transit system.

In addition to the benefits to which a dollar value or some other measure can be assigned, every transit system provides benefits to the area served which defy the assignment of numerical values. These include convenience of travel, reduced urban sprawl, reduction in noise, protection of natural surroundings and other advantages that are not attainable in an auto-dependent society. A measure can be applied to the reduction of air pollution because of transit, but not to an improved view of the mountains; to the time saved by avoiding a traffic jam, but not to the frayed nerves saved; to the cost of freeway construction eliminated by transit, but not to the visual attractiveness of open land that may be the result.

Both measures are important in assessing the worth of public transportation — the tangible and the intangible benefits. A detailed analysis of these two measures is underway at the time of preparation of this summary report and it will be completed at a later date. The purpose of this discussion of benefits is to highlight some of the considerations that are part of the detailed analysis of transit system benefits.

Intangible Benefits

The RTD determined early in its planning process that a high priority should be placed in this region on benefits, such as preservation of positive environmental and ecological characteristics of the area, which can't be measured in exact terms. Thus in measuring the contribution of the RTD plan to the region, it is important to give consideration to both the intangible and the tangible benefits.

Many of the intangible benefits already have been discussed or will be covered in later chapters. They include the influence that transportation — public or private — can have on the orderly organization of development of a region. Urban sprawl is a product of auto dependence. Public transit helps organize growth into concentrated areas of housing, commercial and cultural centers while permitting parks, recreation areas and agricultural land to remain.

With transit, the trip to and from work becomes a relaxing period of the day, rather than a struggle. A shopping trip downtown no longer involves a search for parking, and outlying shopping centers can convert some land now reserved for auto parking to new stores and other facilities. For every auto that public transit removes from a city's streets, there is one less horn to blow, one less engine to roar and four less tires to protest loudly in a sudden stop.

A more definable measure of intangible benefit, although still not calculable in dollars or any other exact measure of benefit, is improved access for residents to employment, education, medical facilities, and cultural and recreational opportunities.

Improved accessibility resulting from public transit is most important — and in many cases vital — to those residents of the District who today have no form of transportation available, because they are not served by existing public transit, or they are unable to operate or own an auto because of age or financial circumstances. But accessibility to employment, education or recreation via public transit is also meaningful to all other residents of the District who may depend today on the auto for transportation.

Each of the opportunities mentioned was identified and mapped in the region. Improved access with the RTD transit system completed was compared with access today by existing public transportation. The analysis indicates that access to employment opportunities within a 30-minute-or-less transit trip will improve nearly three times with the RTD system. Access to educational institutions, within a trip of 25 minutes or less, will improve almost 2½ times. Access to medical facilities, 25 minutes or less away, will increase substantially, and cultural and recreational centers will be twice as accessible within the same trip time limit.

Accessibility to employment or education for those without transportation today — 25 percent or more of the District's residents — may mean the difference for them between making a contribution to or becoming dependent on the community. For many others public transportation is the difference between isolation and mobility.

Tangible Benefits

The detailed analysis underway assigns dollar and cents savings where possible to specific items that can be measured. These include economic benefits such as time savings, reduced automobile operating costs, insurance savings, lower auto accident rates and the elimination of the requirement for a second auto in some families. These and other items are tangible benefits that can be measured to some degree of accuracy through analysis of regional characteristics with and without an extensive public transit system.

For example, it is estimated that today, the out-of-pocket savings in using transit instead of an automobile is 4.9 cents per mile. In addition, savings in accident costs throughout the region amount to 1.7 cents per mile. Other savings for a person who now drives a car to and from work are approximately $10 per year in insurance premiums and $400 per year just to own a second car exclusive of operating costs and parking charges.

With a few assumptions, the savings between using transit and the out-of-pocket cost of using an automobile to and from work can be determined. An average RTD resident who uses a car to drive 10 miles each way to and from work, 250 days a year, would save $120 assuming 4.9 cents per mile auto operating cost, an average of $50 annual parking charge and a 35 cents transit fare.

Automobile Costs	
Operating (4.9¢ x 20 mi. x 250)	= $245
Parking	50
Total	$295
Transit (35¢ x 2 x 250)	= $175
Savings	$120

The more detailed analysis that is being prepared also applies per hour savings to travel time spent by the average person. The value range developed in the analysis is $2.20 to $2.40 per hour. A total value for time saved by residents of the region by riding transit as compared to driving an auto is being computed. Similar dollar values and savings are being computed for truckers, who will save time, not by riding transit, but because of reduced highway congestion. Those residents who for one reason or another will continue to commute by auto will realize the same type of time savings as that by truckers.

Still another cost savings will be realized by eventual elimination of operating cost subsidies necessary today for existing public transportation systems in the District. As outlined in the next chapter of this report, bus systems of any size must operate at a deficit if fares are to be kept reasonable. The PRT system, on the other hand, can produce a sizable surplus at reasonable fare levels. The net result of the extensive bus system and PRT network planned by RTD will be an operating surplus, thus eliminating the deficits for bus operations which are being paid for by more than half of the region's taxpayers today.

The "quality of life" in this region means different things to different people. But for many, a principal advantage of living in Colorado is the natural beauty of the state. For others, simply maintaining the present way of life is the over-riding consideration. Between the two concerns are the majority of the citizens of the region who attach varying degrees of importance to each.

RTD has attempted to plan a system that recognizes the varying desires and needs of the residents of the District. Each citizen must individually assess the benefits which improved public transportation can mean to him personally and to the community as a whole, and weigh these against the cost that he will be expected to bear. The latter is the subject of the next chapter.

Every resident of RTD, regardless of income level, age or personal interest, stands to benefit by some measure through the development of an effective regional public transportation system in the District.

7

Costs and Financing

RTD faced key decisions during the past year as the public transportation concept was developed into a transportation plan. When preliminary cost estimates were made, it became clear that within current statutory funding limitations, RTD could not construct a system which would sufficiently accomplish its objectives. The RTD board of directors determined that, within reasonable limits, costs should not be the primary consideration in achieving the objectives RTD believed the 1969 Colorado General Assembly expected to be accomplished.

Operating costs are determined by the level and quality of service provided to passengers on a public transportation system. The level and quality of service also affect the attractiveness of the public transportation system and thus the numbers of riders that use it. Because the residents of RTD are highly auto-oriented, the board of directors decided that only high quality service at a high level of convenience with a reasonable fare could be expected to attract the auto owner and passenger to use public transit.

These decisions resulted in a requirement for re-examination of the financial plan provided to the District in the act that created it. RTD employed the First Boston Corporation of New York and Kirchner Moore and Company of Denver as consultants to examine the current capital cost financial plan of the District and to recommend a new financial plan which would permit accomplishment of its objectives. Conclusions on both the public transportation and the financial plans could then be submitted to the Colorado General Assembly for consideration and possible implementation.

Construction Costs

The estimate of construction costs of the system was made in 1973 dollars—in other words, the cost of the system if it could be built today without any effects of future inflation on the dollar. This amount was determined to be $1.085 billion at 1973 cost levels.

A construction schedule was developed which called for start of design in early 1974 and completion of the system in 1983. It also established the amount of funds needed each year during the period. Working with the financial consultants, the Joint Venture developed an allowance for inflation of construction costs during the next 10 years of 7 percent compounded annually. When applied to the 1973 dollar figure, the consultants estimated that $1.6 billion actually would be spent on construction by 1983 or in other words, that inflation would add about $515 million to the construction costs of the system in the next 10 years.

Construction cost estimates were based on drawings prepared from the engineering study and system criteria. The capital cost elements of the system include:

- construction of all fixed physical elements of the PRT system such as guideways and stations
- PRT vehicles
- acquisition of existing bus systems, purchase of new buses and bus related facilities
- right-of-way acquisition
- system integration, engineering, procurement, and construction management
- system check and testing cost
- contingency funds
- landscaping

A summary of these costs is outlined in the accompanying table. Each of the individual elements of the total cost was further broken down into specific items, such as lighting in the stations, closed circuit television cables, nursery stock for landscaping, spare parts, easements and system testing. The number of PRT vehicles provided for in the estimate is sufficient to meet RTD requirements for a number of years, but it is possible that increased transit demand will require additional vehicles before the year 2000, and additional capital funds will need to be raised. On the other hand, if inflation does not occur at the projected rate, the initial system might cost less and thus funds would be available for capital additions.

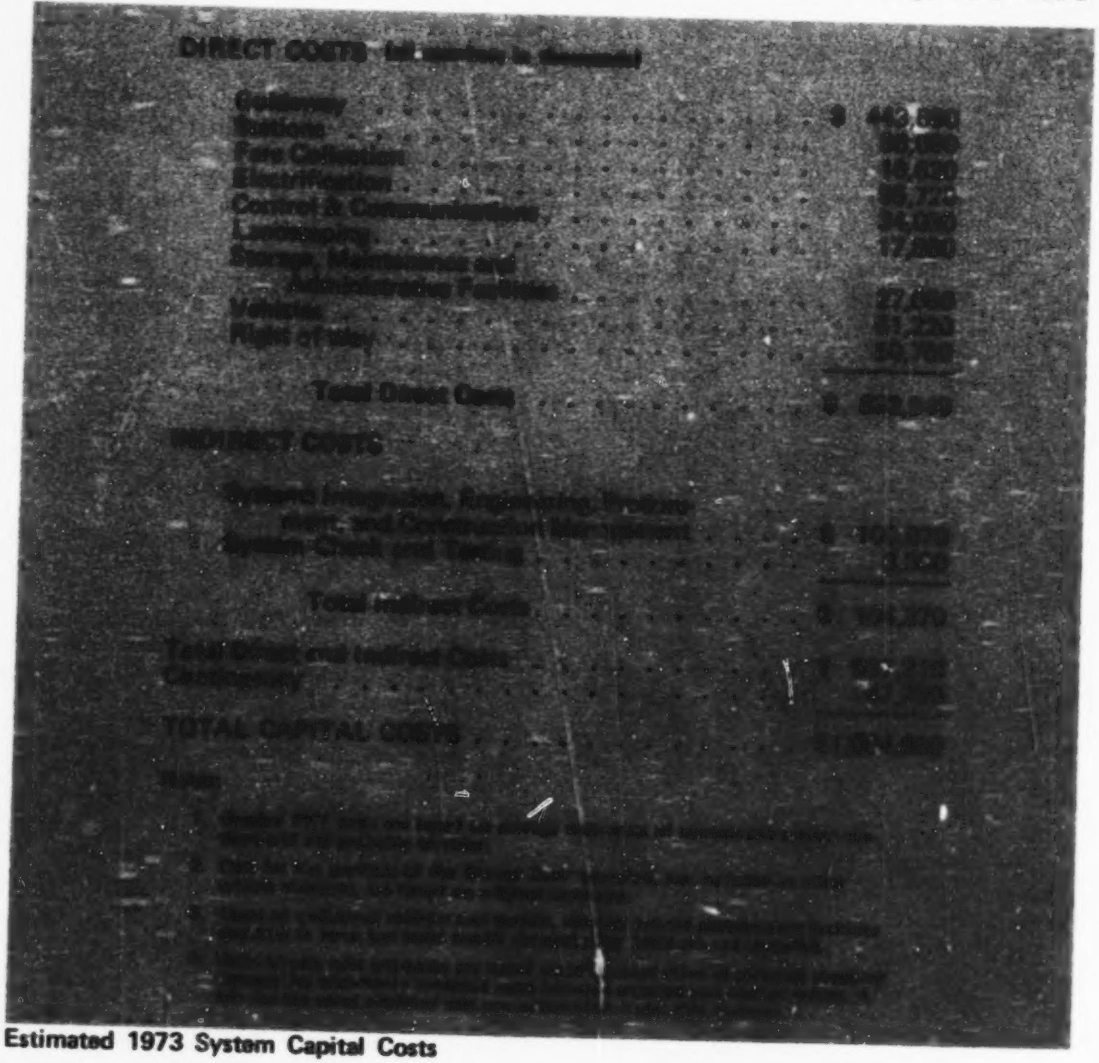
A very important part of cost estimating is the allowance provided for contingencies. The construction cost estimate for RTD is as detailed and as exact as possible at this time. Using factors developed through experience on each cost element, an overall contingency of 16 percent was allowed for the project.

Both the contingency and inflation factors are considered safely conservative. The RTD board of directors decided that these factors should be high so that together they would protect the residents of the District from any surprise increase in total costs in the future.

Operating Costs

Very few public transportation systems in the nation operate at a break-even position, let alone make a profit. In many cases, this is because the systems were designed and built many years ago when efficiencies of operation that have been developed in recent years were unknown. In the case of most private systems, it has proved impossible to pay for both capital construction costs and operating costs from the fares passengers were willing to pay which is the reason many have either gone out of business or have been acquired by local governments in order to preserve essential transportation service.

The solution has been public ownership with capital costs paid through some form of public tax, plus modernization to take advantage of new operational techniques that can save money. The result has been public transit service at a cost the average citizen could



DIRECT COSTS [illegible]	
Guideway	$ [illegible]
Stations	[illegible]
Fare Collection	[illegible]
Electrification	[illegible]
Control & Communications	[illegible]
Landscaping	17,200
Storage, Maintenance and Administrative Facilities	[illegible]
Vehicles	[illegible]
Right of Way	[illegible]
Total Direct Costs	$ [illegible]
INDIRECT COSTS	
Systems Integration, Engineering, Procurement, and Construction Management	$ [illegible]
System Check and Testing	[illegible]
Total Indirect Costs	$ [illegible]
Total Direct and Indirect Costs	$ [illegible]
Contingency	[illegible]
TOTAL CAPITAL COSTS	$[illegible]

Notes:

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]

Estimated 1973 System Capital Costs

afford. The $1.5 billion BART rapid transit system in San Francisco has been paid for through a district-wide tax, but is expected to pay for its own operating costs at fares acceptable to the public.

Although the 1969 General Assembly provided RTD with a 2-mill operating subsidy that could be levied if needed, the RTD policy is to make the system meet its operating costs from the fares while keeping the fares at a reasonable level.

To determine an estimate of overall operating costs, RTD consultants examined four components:

- patronage of the system
- fare structure
- PRT operating cost
- bus operating cost

Patronage, or the number of riders, is the key element in determining operating cost. The patronage information was developed by the Joint Regional Planning Program and provided to the consultants by RTD. The information was developed for the year 2000, but interpolated for the intervening years based upon projected population growth. The resulting estimates for the year 2000 are that 461,000 passengers per day would ride the PRT, and that 702,000 would ride buses, including 243,000 on express buses and 459,000 on local buses.

A detailed fare structure was not developed at this time. But for planning purposes, an average fare of 35 cents was used to estimate system operating revenues. The 35 cents fare was inflated through the year 2000 at a 3 percent rate. At a later date, RTD will develop a comprehensive fare policy and rate structure that will include such elements as special fares for youths and senior citizens, and different fares for different types of service—bus or PRT.

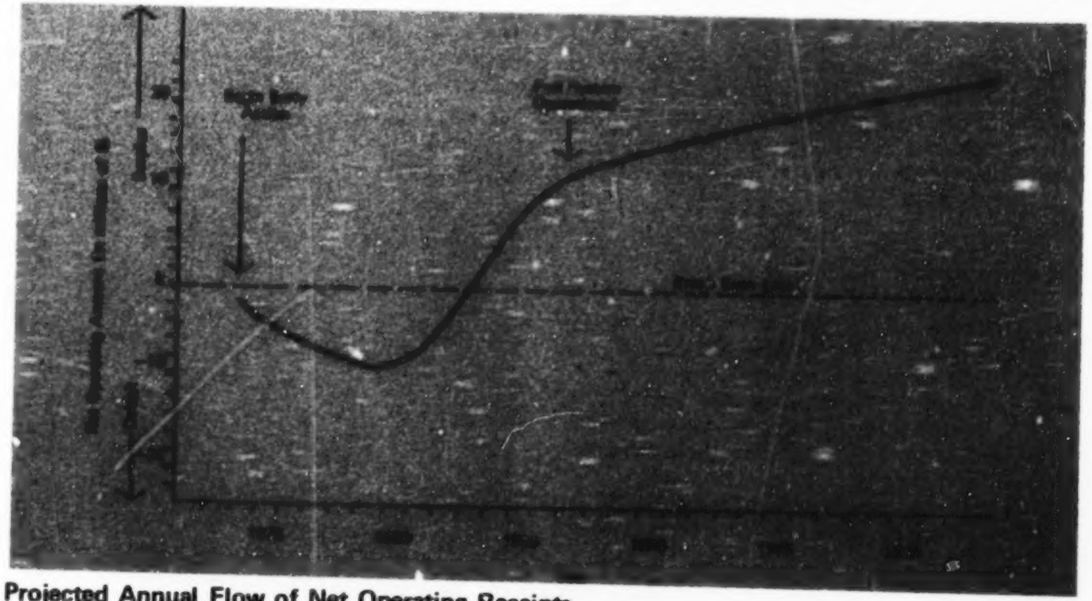
The estimate of PRT operating costs is based on examination of similar systems either in operation or planned. In addition to the patronage cited, the cost estimate assumed a 12-passenger vehicle operating at least half full all the time it is in operation, an average trip of five miles per passenger, and a cost of $5.10 per hour of vehicle operation.

Considerable operating experience is available on bus systems so that, except for the factor of inflation, operating costs are relatively firm figures. The estimate of annual costs per bus is $28,000 to $30,000, assuming an average life for a bus of 15 years, and variable sizes from 20 passenger to 50 passenger. The estimated operating deficit for the bus system is $5 million to $7 million by the year 2000.

Net Operating Picture

Sufficiently conservative factors were applied to calculations of both operating costs and operating revenues so that projections of deficits or profits would be realistic.

Based on the assumptions outlined above, the PRT and bus transit systems will operate at a deficit from 1974 to 1983, when the PRT becomes fully operational. The maximum annual deficit projected is about $7 million in 1978-1979 when the regional PRT system will begin operation. The amount is in inflated dollars, or the expected actual dollar cost in that year based on inflated fares and operating costs. An operating surplus or profit is projected for every year from 1983 through



Projected Annual Flow of Net Operating Receipts the year 2000, when an operating surplus from the system of $22 million inflated is projected.

In inflated amounts, operating costs are expected to rise from $11 million in 1974 to $150 million in the year 2000, while revenues are expected to increase from $9 million to $172 million in the same period. In 1990, operating costs are expected to be $93 million with revenues of $109 million.

The PRT system operates at a profit throughout the period after it opens in 1983, more than counterbalancing the losses expected from bus operations. A policy decision for RTD will be necessary concerning the net operating projections. Profits earned could be used to expand or improve the system. Or, although the average fare used in the calculations is believed to be reasonable, fares could be reduced even further to keep surpluses at a minimum.

The projections do clearly indicate that the RTD objective of at least matching operating costs with operating revenues will be possible. Until that happens, RTD has the authority to levy a tax of 2 mills to meet deficits.

Capital Cost Financial Plan

The financial plan proposed by RTD is a practical program for paying the capital cost of the proposed transit system. The plan is the result of examination by RTD and its consultants of experience in other cities confronted with similar capital needs as well as a careful consideration of alternative revenue sources that could be used to raise the local share of total system costs.

Total system costs, after taking account of probable cost inflation, are estimated at $1.6 billion. It is expected that two thirds of this amount or $1.067 billion will be provided by federal grants, primarily capital grants under the Urban Mass Transportation Act of 1964. The remaining one-third or $533 million must be raised locally.

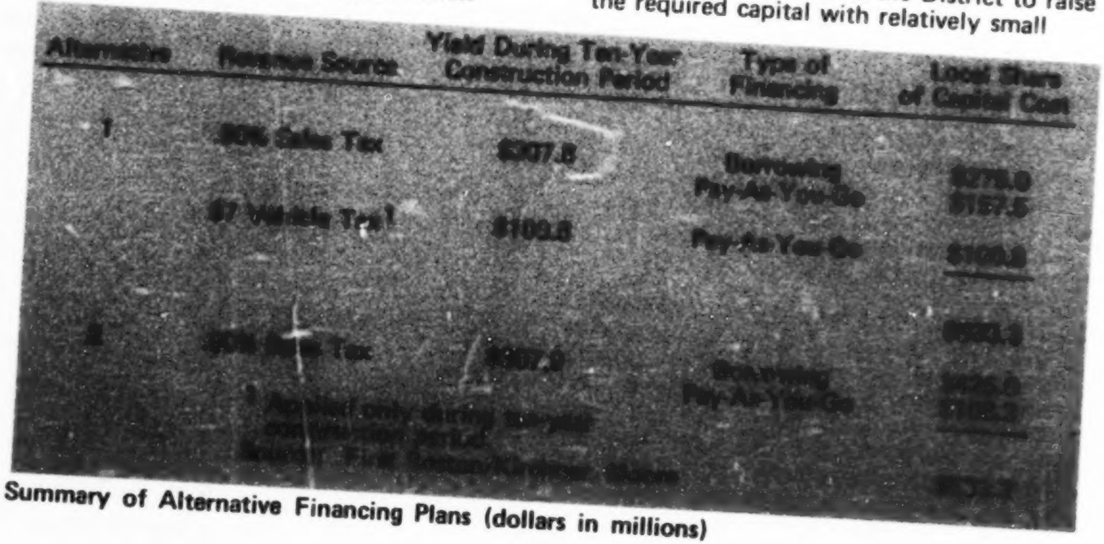
The recently announced 1974 federal budget continues the transit aid program at its current level of $1 billion annually. Legislation has been introduced to increase the level of federal funding and also to increase the federal share to more than two-thirds. The intent of existing federal transit aid legislation is to provide a $10 billion program over a 12-year period.

Under existing RTD legislation the District may borrow up to 4 percent of the assessed valuation of property in the District for capital purposes and it may support debt service on this borrowing from property tax levies. Based on projections of growth in assessed value, it is expected that this would allow RTD to borrow only $220 million by the end of the construction period as shown in the table. This is far short of the $533 million local share. Therefore, alternative or supplemental sources of local funds have to be found.

RTD and its financial consultants analyzed revenue sources used by other cities to fund the local share of new transit systems and also considered several additional possible revenue sources to fund the local share of new transit systems. Most other cities building urban transit systems have relied either on a property tax, a sales tax or both, although there is some precedent for vehicle taxes and excise taxes as well. These and other possible revenue sources were analyzed, including vehicle ownership tax, gasoline tax, income tax, cigarette and liquor taxes, airport tax, employee head tax and utility taxes.

In addition to considering alternative sources of local revenue, two principal methods of raising capital were analyzed—borrowing and pay-as-you-go.

Borrowing would enable the District to raise the required capital with relatively small



Alternative	Revenue Source	Yield During Ten-Year Construction Period	Type of Financing	Local Share of Capital Cost
1	[illegible] Sales Tax	$307.5	Borrowing Pay-As-You-Go	$275.0 $157.5
	$7 Vehicle Tax¹	$100.5	Pay-As-You-Go	$100.5
				$533.0
2	[illegible] Sales Tax	[illegible]	Borrowing Pay-As-You-Go	[illegible] [illegible]
				[illegible]

¹ Applied only during ten-year construction period.

Source: [illegible]

Summary of Alternative Financing Plans (dollars in millions) initial tax revenues. However, interest costs over the life of long-term borrowing would be quite large and require that taxes be levied over a long period of time. Pay-as-you-go eliminates interest costs but requires large immediate tax levies to provide capital requirements directly from revenues.

As a result of this analysis, all tax sources except the sales tax and vehicle ownership tax were eliminated, either because (1) they produced insufficient revenues at reasonable levels (such as cigarette and liquor); (2) they encountered serious constitutional limitations (such as gasoline and income); or (3) their public acceptance was questionable (such as property and head tax).

After considering several alternative plans involving sales tax and vehicle ownership tax as revenue sources and borrowing and pay-as-you-go as financing methods, two alternatives were selected as feasible and appropriate means for raising the $533 million local share. These alternatives are summarized in the table.

Alternative No. 1 combines a ½ percent sales tax plus a vehicle ownership tax averaging $7 per vehicle per year. The current average is $20 per vehicle per year. The vehicle tax would be a temporary tax expiring upon completion of transit construction in 1983, while the sales tax would continue until all bonds were retired. Alternative No. 2 would rely exclusively on a ½ percent sales tax to support capital costs. Both alternatives would permit elimination of the existing RTD property tax as a source of capital financing. Both combine borrowing and pay-as-you-go methods of financing.

The basic difference between the two alternatives is the proportion of system costs which is financed by borrowing and on a pay-as-you-go basis. Alternative No. 1 would require $275 million in borrowing while Alternative No. 2 would require $425 million. Thus Alternative No. 1 would reduce interest payments by about $160 million over a thirty-year period, as shown in the table.

A second major difference between the two alternatives is that Alternative No. 1 provides more flexibility and more total capital raising potential than Alternative No. 2.

Should additional capital need to be raised, borrowing under Alternative No. 1 could be increased substantially.

Detailed information regarding the timing of capital needs during the ten-year construction period and the rate of cost inflation assumed are contained in the financing portions of the Technical Information.

[illegible] Assumed [illegible]	[illegible]
Maximum System Cost Possible[2]	[illegible]

[1] Based on [illegible] 1981 [illegible]

[2] [illegible] in 1973 dollars.

Source: [illegible]

Maximum System Cost Possible Under Existing Legislation

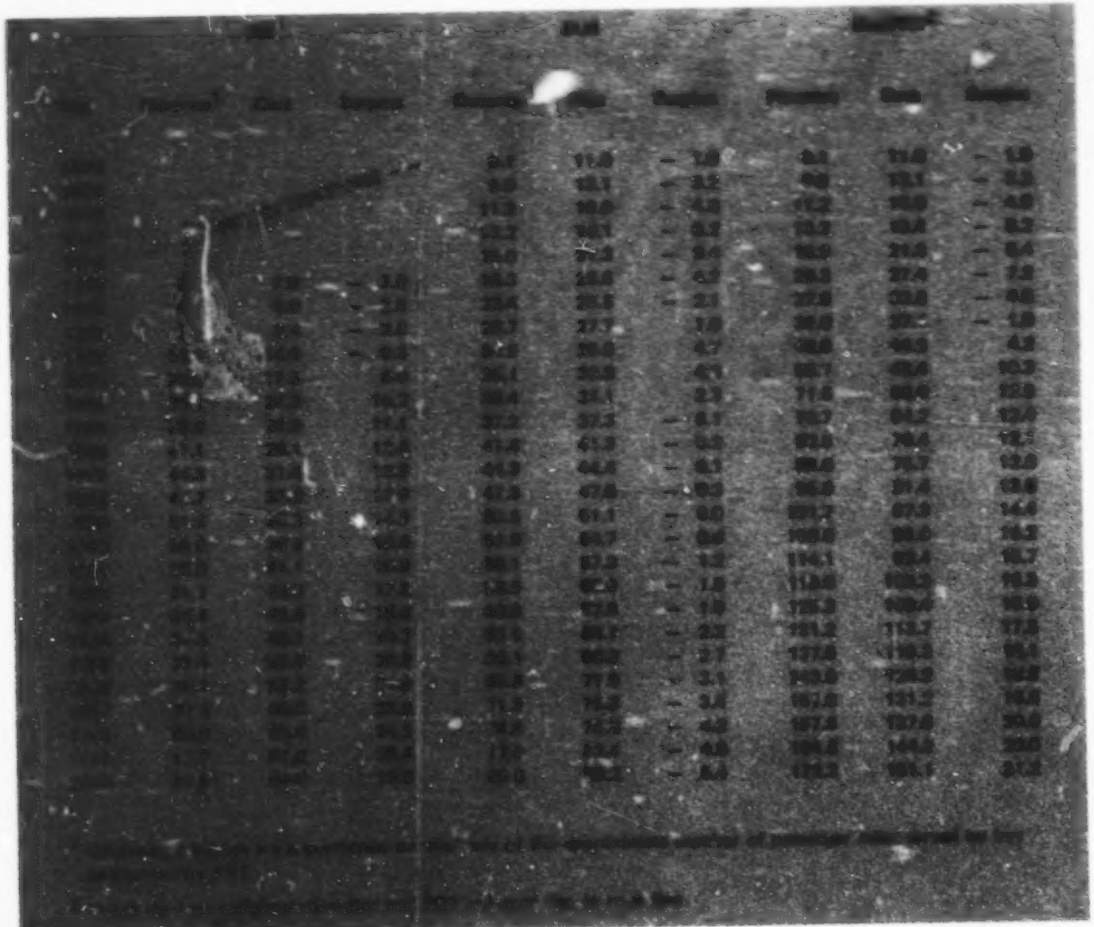
Borrowing—Alternative 1	[illegible]	
Total Interest Cost—Alternative 1 (1)		[illegible]
Borrowing—Alternative 2	[illegible]	
Total Interest Cost—Alternative 2 (1)		[illegible]
Interest Savings of Alternative 1 (in [illegible])		[illegible]

(1) [illegible]

Source: [illegible]

Interest Savings of Alternative 1

To place the suggested alternatives in perspective, the average family of four in the District with an annual adjusted gross income of $10,000 would pay approximately $22 per year in additional taxes because of the ½ cent sales tax based upon the Internal Revenue Service optional sales tax table. In the case of the alternative that includes the average $7 per year motor vehicle ownership tax, the same family would pay approximately $29 annually if it owned one car or $36 if it owned two cars. The auto-ownership tax could be dropped at the end of 10 years or after the transit system is constructed. To put this analysis in further perspective, the cost of owning an auto today, including depreciation, gasoline, insurance, maintenance and other expenses, is estimated to be more than $1,400 per year.



Comparison of Bus, PRT, and Bus/PRT Revenues and Cost

8

Recognizing the Problems

The proposed public transportation plan of the Regional Transportation District is contingent on the successful accomplishment of a number of objectives and goals, in addition to voter approval. Not the least of these is a change in the limit of funding that was set by the Colorado General Assembly in 1969. After two years of intensive study, the RTD board of directors on February 15, 1973, tentatively adopted a plan RTD believes meets the transportation requirements of the District. Under existing legislation, RTD could build a system less than one-half the size it has determined is necessary for this region.

The RTD has asked the 1973 Colorado General Assembly to consider raising the limit on financing set in 1969. While the RTD recognizes the wisdom of setting a limit, it has asked the legislature to examine the situation in light of the information that has been developed since 1969. In addition, the only taxing authority granted the District to fund capital construction is the property tax which is generally considered unpopular. The changes suggested by RTD for the consideration of the General Assembly are outlined in the previous chapter.

The Minimum System

If RTD is limited to the present legislative authority of its act, a smaller system, meeting a reduced set of objectives and of reduced beneficial impact on transportation, land use and the environment, could still be built. With the qualifications cited, this system still would make a positive contribution to the expansion of public transportation in the District. Reevaluation of system hardware, compatibility with the highway system, and of station locations would be necessary.

Some resolution of immediate transportation problems, some reduction in congestion, and provision of some transit access to transit dependents or those currently without travel opportunity would be possible with the minimum system. To a very limited degree, metropolitan corridors within the reach of the PRT system would be reinforced. In order to help guide regional growth patterns, RTD must be a pacesetter in the region. This cannot be accomplished, however, within the limited financial resources of the existing legislation.

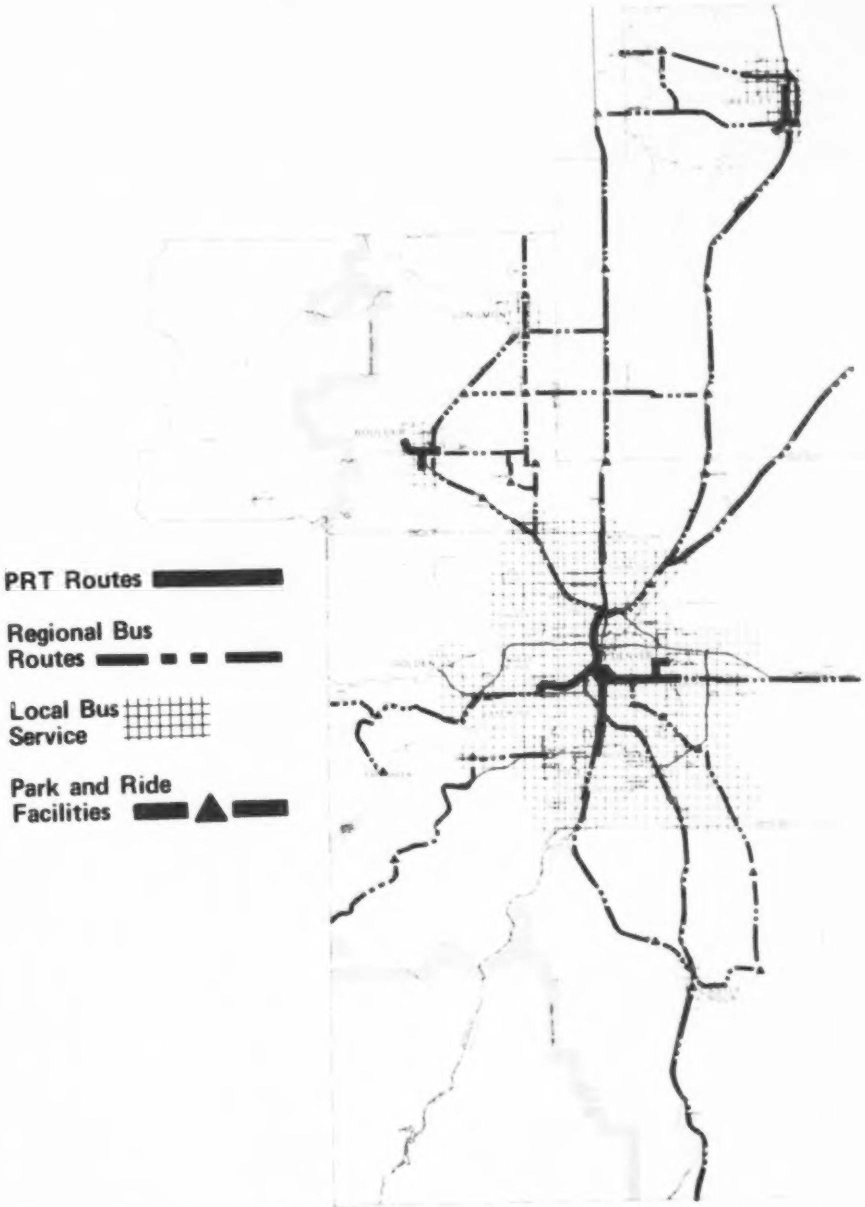
Auto intercepts would form an important part of the minimum system. It would include four major auto intercept points, one each to the north, south, east and west of downtown Denver. The aim of the auto intercepts is to intercept a portion of the commuters from outside the core of Denver, store their cars in garages or surface parking areas associated with the centers, and transport the commuters quickly and inexpensively from there to the downtown area or to other destinations. The transportation centers would provide not only an integration of automobile and PRT transportation modes, but also bus.

A key issue which will have to be resolved before the details of technology are decided upon, is whether the minimum system, if it is the choice, is to be considered the total system for the next 30 years, or part of a potentially larger future network subject to later voter approval. If this system is part of a larger future network then the vehicle control, communications and fare collection systems will have to be comparable to those required for the future system. The fare collection system, for example, would be relatively expensive since it would be designed to be integrated into a much larger system. It may also be desirable to acquire right-of-way for the future system because land value inflation is so great. If the system is approached in this way, a relatively small amount of the funds would remain for the fixed guideway system as proposed.

Alternatively, this minimum system could be considered the total system for the coming 30 years. In that case, technological selections would be based on more limited networks and thus would be comparatively less expensive. However, this alternative will severely limit flexibility for system expansion in the future. Problems of integrating this system with future additions are certain to be enormous.

An early decision for RTD, if limited to the minimum system, will be whether to build it with provision for expansion after a short period of time or whether it should be built to be the total system for 30 years or more.

The RTD must also provide for the residents now without any transportation. Because of financial constraints, it would not be possible to provide this service by a fixed guideway system to those without transportation living in outlying areas. The service would have to be provided by express and regional buses.



Regional Minimum System

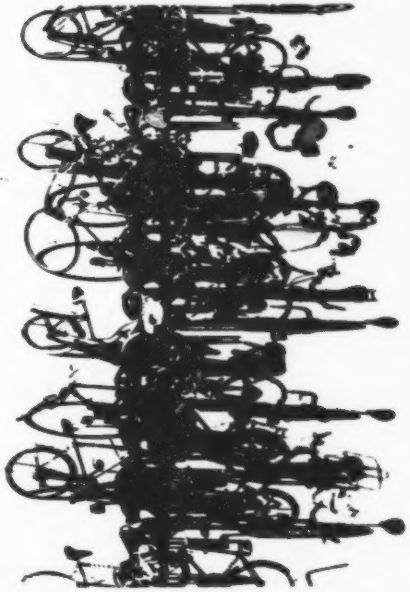
9

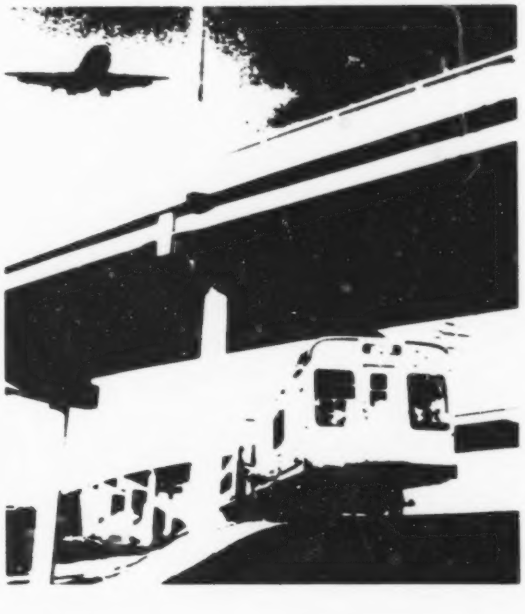
The Future With Transit

How much more pleasant will it be to board a modern bus or PRT car for a fast, quiet, comfortable ride than to fight today's metropolitan traffic congestion? Before long, it may be possible.

Transit will bring new freedom to the people of this District—freedom which today is contingent on owning and driving a car. Each day a quarter of the regional population faces a problem of how to get where they want to go. Usually they have to depend on someone else to take them or they don't get there at all. Others with autos spend a great deal of time driving children, the elderly and handicapped friends to and from many places every day. Transit can take over for many of these trips.

Part of the freedom comes in saving more time for the better things in life. And most of those better things will be more convenient. A transit alternative will make schools, libraries, museums and theaters more accessible, to more people, without parking problems. People will be freer to take advantage of many opportunities lost now just because getting to them is a problem.

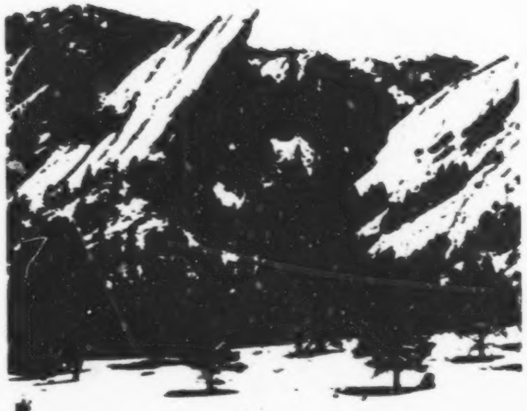




Balanced Transportation

Balanced transportation can also lower many of the individual expenses of unnecessary trips—expenses like parking, insurance, accidents, and automobile operating costs. Modern, convenient rapid transit may eliminate the need for many second family cars.

Not only will travel become easier, less expensive and more convenient, it will be safer. The District will have fewer autos than it would have had without a transit system. As a result, there will be less traffic congestion on our streets and highways, fewer accidents and fewer needless highway



tragedies. Most people will continue to drive for some of their trips and even then driving will be safer, more pleasant and more convenient because of reduced congestion.

Balanced transportation is environmentally sensitive to the future of the region. Without it, noise, smog and poor planning for people will further degenerate cities to the point where they may be lived in, but they are no longer liveable.

Development of a balanced transportation system will give local authorities an option they presently do not have. In cooperation with RTD, local governments can reinforce land use plans using transportation as a tool. Transit can be used to strengthen existing urban centers and encourage new centers only where economic, social, environmental and ecological factors dictate their desirability.

Savings for the Future

The broader, intangible contributions transit will make to this region are impossible to relate to dollar values, but they may prove the most valuable in the long run.

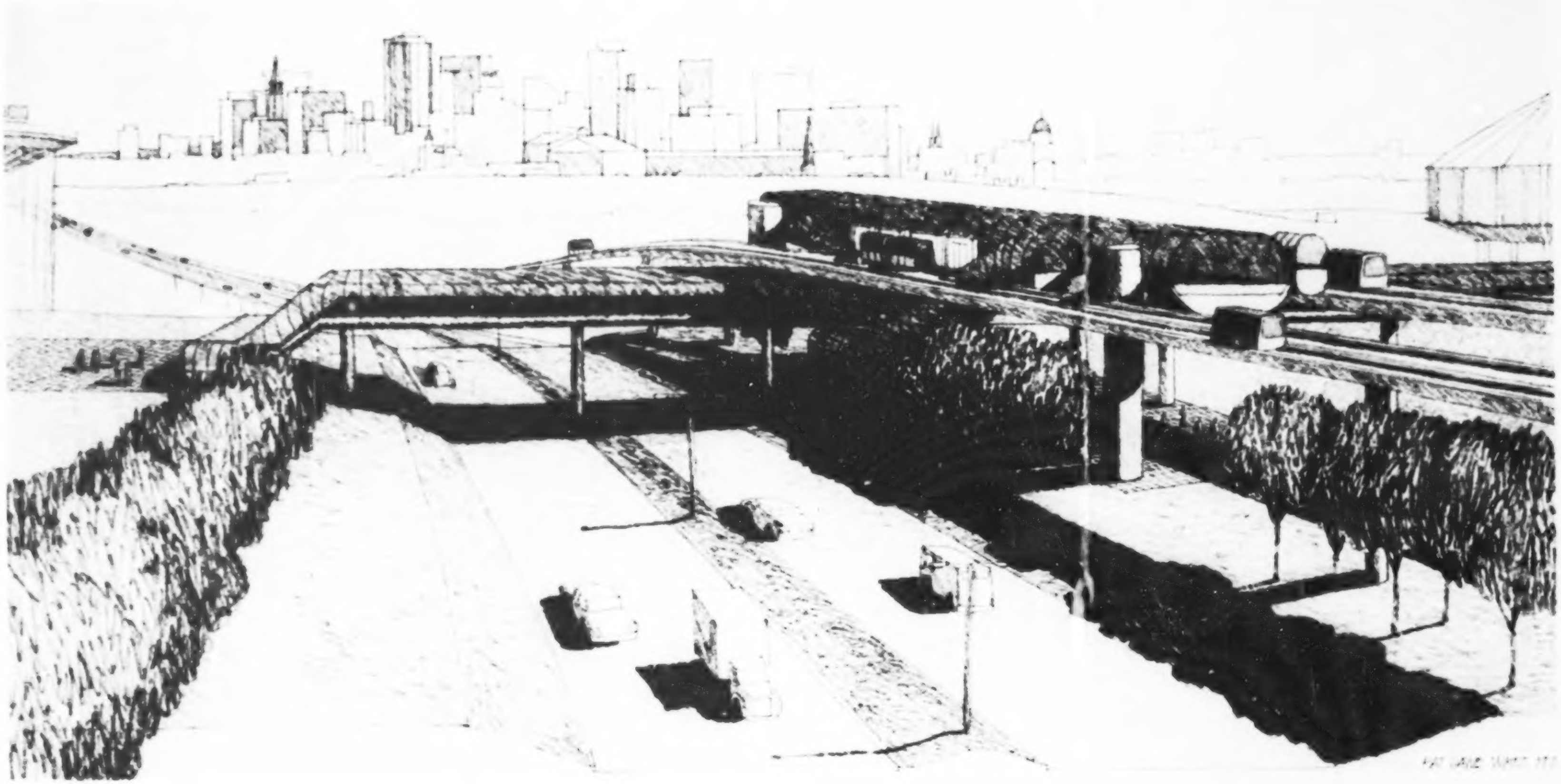
The importance of some may be learned only in the future as a transportation system is developed. Conservation of energy is important today--it could be vital in a few years. Transit requires an energy source to transport people, but it is a vastly more efficient expenditure of energy for the movement of people than is true with the automobile. If the energy shortage should deteriorate to the point where fuel supplies had to be curtailed for other forms of transportation, transit could be absolutely necessary to fill the gap.

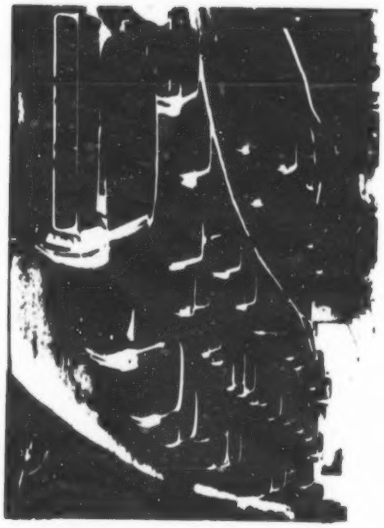
The effects of smog on people, buildings, wildlife and vegetation can only be learned over a long period of time, a study which is in its infancy. The impact on people of the noise of traffic and the frustration of congested streets and highways is an unknown. How important to general well being is the availability of open space and parks?

Whatever the problems that may become clearer in the future and whatever contribution transit might make toward their solution, the benefits will be realized by all the people of the region. The measure of the return on an investment in public transportation will not be exact. Other major cities of the country, noted for a progressive attitude, have decided to make that investment. New systems under construction or development include San Francisco, $1.5 billion; Atlanta, $1.4 billion; Houston, $1.4 billion; Baltimore, $1.7 billion; St. Louis, $1 billion; Washington, D. C., $3 billion, and Minneapolis-St. Paul, $1.0 billion.

Conclusion

In the coming months, the Regional Transportation District's plan for balanced transportation will be reviewed formally and informally with officials, organizations and citizens throughout the region. With the advice of this many people, RTD will make final revisions to the plan. In the fall of 1973, most likely in October, the voters of the District will be asked to decide if they want a balanced transportation system, and if the plan submitted by RTD will satisfy the future requirements of this area. Delays in the decision will be costly—during the first year of any delay, the cost of the system will increase at an estimated rate of $144.50 per minute because of inflation. The region has the fortunate opportunity to act today to solve problems of the future.





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